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[OFFICIAL NOTICE.]

Eighth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY,
415 POST STREET, SAN FRANCISCO, CAL.,
June 23, 1900.

The eighth annual meeting of the Pacific Coast Gas Association will be held in San Francisco, Cal., at the offices of the San Francisco Gas and Electric Company, 415 Post street, Tuesday, Wednesday and Thursday, the 10th, 11th and 12th of July, 1900.

The following papers will be read:

"President's Address," by Mr. John Clements.

"Some Notes on Larger Types of Gas Engines," by Mr. J. B. Crockett.

"The Best Method of Introducing Gas Stoves," by Mr. John A. Britton.

"The Use of Crude Petroleum for Firing Benches," by Dr. R. M. Powers.

"Thoughts Suggested by Boilers Explosions," by Mr. T. R. Parker.

"The Investigation of Gas Processes," by Mr. Alex. C. Humphreys.

"The Synthesis of Commercial Gases," by Mr. L. P. Lowe.

In addition to the above Mr. A. S. Cooper, California State Mineralogist, will deliver a lecture entitled "Some Physical and Chemical Characteristics of California Petroleum."

"Wrinkle Department," edited by Mr. G. H. Hollidge.

"Experience Department," edited by Mr. O. M. Gregory.

On Wednesday evening, July 11th, a theater party will be given, and on the following day, Thursday, an "Outing," the details of which will be kept as a surprise to members. After long and serious debate the Directors have fixed upon an objective point, by far the most beautiful in all the surrounding country. A sumptuous repast will be served upon arriving there, and ample provision made for the entertainment of guests.

It is desired that members make liberal contributions to the "Question Box," and every effort will be made to answer them satisfactorily. To facilitate this work questions should be in the hands of the Secretary not later than July 1st, in order that they may be assigned to the proper authorities and receive due attention.

A number of interesting exhibits have come to hand in the course of the year, and these will be displayed in the meeting room for the inspection of the members present.

Prior to and during the meeting the Secretary will be at headquarters, 415 Post street, and on Monday evening, July 9th, as well, where he will be glad to meet members and furnish information.

J. B. GRIMWOOD, Secretary.

BRIEFLY TOLD.

THE EIGHTH ANNUAL MEETING OF THE PACIFIC COAST GAS ASSOCIATION.—The current notice in the JOURNAL, respecting the eighth annual meeting of the Pacific Coast Gas Association, which is to be held in San Francisco, the 10th, 11th and 12th days of the month, goes to show that President Clements, Secretary Grimwood and their committee associates have been up and doing. Not only does the notice reveal their successful activity, but it also plainly brings out the satisfying fact that the rank and file of the Association were heartily in accord with their officers in insuring the preparing of a programme, which

✓R v.73 July-Dec. 1900

from a technical point of view is up to the highest mark. Besides the President's address the members are promised no fewer than six papers, all on subjects that are quite close in touch with advanced and advancing practice in gas manufacture and supply. The names of the authors are further guarantees that what they have to say on the selected themes will well be worth the close attention of the delegates. The programme further numbers a lecture by Mr. A. S. Cooper, whose fame as a mineralogist is not confined to the limits of the Pacific Coast. His subject, "Some Physical and Chemical Characteristics of California Petroleum," holds great interest for Coast gas men. The technical portion of the sessions will be concluded by the respective budgets submitted by Editors Hollidge and Gregory, the former of whom has been for months amassing "Wrinkles" for his fellows to smooth out, while the latter has been quite successful in netting or landing a number of "Experiences." Surely, then, from these good stores of information one may not say other than that the meeting is bound to be a rousing success from a professional point of view. And if that pleasing prediction is certain of coming true, at least no less of success lies in the promise of the convention from its social side. A theater party for the evening of the second day, and an "Outing" for the last day, are billed, and although those in charge of the "Outing" decline to reveal just now the "objective point" thereof, Secretary Grimwood's hint or declaration that the "point" is "by far the most beautiful in all the surrounding country" is enough and to spare in the line of assurance that the open handed, true hearted hospitality of the Coast will surely be framed in a gorgeous setting. As usual, the San Francisco Gas and Electric Company has seen to it that the Association will lack nothing in the way of suitable meeting room and headquarters accommodations. We have good reason for the statement that the meeting will be attended by quite a delegation from our side of the divide.

DEATH OF MR. JAMES M. STARR.—We have received, under date of the 25th of June, through the courtesy of Mr. James Somerville, of the Indianapolis Gas Company, brief mention of the death of Mr. James M. Starr, who for quite well over 25 years had controlled the management of the Richmond (Ind.) Gas Light Company, or until it was merged a comparatively short while ago into the corporation known as the Richmond Light, Heat and Power Company. We have not been able to gather very much respecting the history of his life in a general way, no children having survived him, but the facts that we have are here related. His death occurred at his home in Richmond the evening of June 17th, after a somewhat prolonged illness. He was born in Philadelphia, Pa., in 1824. He removed with his parents to Richmond while still a very young child, and in that city his education was acquired and there his business career was passed. Beginning in a very modest way, he gradually went on to fame and fortune, gaining a reputation for fairness, perseverance and success and steadily going on to a higher place in the esteem of his townsmen. In the sixties he acquired a controlling interest in the Richmond Gas Light Company and acted as President thereof, until, as before noted, he disposed of his holdings to the proprietors of the Richmond Light, Heat and Power Company. He was elected to membership in the American Gas Light Association at the meeting held in October, 1875, and joined the Western Gas Association in the spring of 1879. For years he attended the sessions of these bodies, and was noted for his activity in connection with the committee work of the Western. Another industry in which Mr. Starr was prominent for many years was that of piano making, the Starr Piano Works in Richmond having through his efforts before he severed his connection with it secured a national reputation. He was noted for his generosity, and public monuments to him in that respect are the church edifice in which the Second Baptist congregation of Richmond worships, and Starr Park, in the northern part of the city. His quaint personality will be remembered and treasured by many an old line gas man, especially by those who were closest to him. He will be sadly missed by the poor of Richmond, whose appeals to him were never made in vain, and they were frequent.

NOTES.—One of the handsomest office buildings in Milwaukee, Wis.—and that is saying a great deal, for there are many handsome office structures there—is that occupied by the Milwaukee Gas Company.——"F. S." is informed that the last dividend declared by the Petersburg (Va.) Gas Light Company was announced on June 19th. The amount was 4 per cent.——The men employed in and around the municipal gas works of Hamilton, O., have appealed to the Board of Control to reduce their hours of work from 12 to 8.——The officers of the new Gas Company for Clinton, Ills., are: President, Charles Ridgely; Vice-President, Wm. H. Odiorne; Secretary, Henderson Ridgely.

[Prepared for the JOURNAL.

Pipes and Piping Connections in Gas Works.

By "ENGINEER."

Some Mechanical Wrinkles for Gas Engineers.—The accompanying set of drawings show some everyday illustrations related to the practical mechanical work of the gas engineer and inspector. There are in these days some very good plans in progress concerning the inspection of gas pipes and gas piping systems and connections, and although the inspector may seem severe at times no one will say that he is not a valuable part of the gas engineering business. The writer has personal knowledge of accidents which were prevented through the watchfulness of the inspector. Time and time again have these inspectors visited a plant and condemned certain pieces of machinery, equipment or piping just in time to obviate disaster, yet the inspector's appearance at the plant is usually the signal for reproaches and remarks as to what business has this man to make us do this and attend to that, and the like. But the inspector has been the direct means of saving many lives and dollars in manufacturing establishments in which there are pipes and piping, steam or other power; or, in fact, wherever any mechanical operations are in process. The inspector looks at weaknesses in pipes or other apparatus from a different point of view than that of the local machinists, or even the proprietor. The local machinists are aware that to discover something which must be fixed means extra work, while the owner of the plant knows that it means additional cost, and business may be such that he is not warranted in spending much money for repairs and improvements; but the inspector has no eye for labor or for costs, and if a piece of work must be done there is no getting out of it, for he has the law on his side, and if what he directs is not attended to trouble and additional cost ensue. So that when an inspector notices defects in piping systems of gas or any other plants, the remedy is usually not long in following.

In the inspection of gas pipes an important factor is the depth of the thread, and Figs. 1, 2, 3 and 4 are given to illustrate this point. In Fig. 1 is shown a sectional end of a gas pipe in which the body portion is represented by dark shaded lines, the thread being light. It can be seen that the depth of this thread is not what it should be, so that when the thread is locked in with its corresponding thread we have an interval, at *A*, as shown in Fig. 3. This will result in leakage and trouble, and can be fixed only by removing the defective joint and re-cutting the threads to the proper depth. But it will not do to go to the opposite extremes, as in Fig. 2, in which is shown a section of a pipe in which the thread is cut too deep. This makes the interlocking of the threads all right, providing that the opposite portion is cut to correspond; but the trouble lies in the increased weakness of the pipe due to removing too much of the metal at the base of the threads. Fig. 2 shows this, the depth of the thread being in white, leaving but a small amount of the metal. The threads may join, as in Fig 4, but still the metal of the pipe is weakened and disaster may follow. Therefore, care should be taken to gauge every cutting and see to it that the threads are cut just the right depth to lock well and full, without going too deep.

Another example is given in Fig. 5 to illustrate the way in which the pipes often break when the metal is reduced to too great thinness between the threads. The least strain on the pipe will very likely cause it to break off at *B*, or at some other point between the threads, and trouble will result.

An Effective Remedy.—When I find that some unskilled gas pipe machinist or engineer has weakened a pipe or system of pipes by cutting into the metal body work of the pipe too greatly, as in Fig. 2, I usually take steps to prevent the breaking of the pipe by brazing in an additional piece of pipe, *C*, as in Fig. 6. This little piece of pipe should be the right diameter to fit inside the main pipe tightly, and should be about one-half inch longer than the threadwork on each side. Then this pipe can be brazed in place, or if brazing is not practical, the piece can be pinned or keyed to place. The piece will support the body of the pipe beneath and near the threads and prevents breaking.

Some Delicate Connections.—Pipe connections of the style shown in Fig. 7 are always difficult to deal with, and should be of the best material and workmanship. This operation of reducing is employed to a great extent in connection with modern apparatus like gas engines, and since the introduction of these little machines so extensively in manufacturing plants for purposes of small power uses gas engineers have had a great deal to do with piping systems in which are involved types like that in Fig. 7. In the first place, every piece in the reducing portion of the pipes should be of superior stock. If there are any pieces of piping about the plant which are of inferior stock, or incorrectly cut or tapped, these should be worked off in any other outfit than that in

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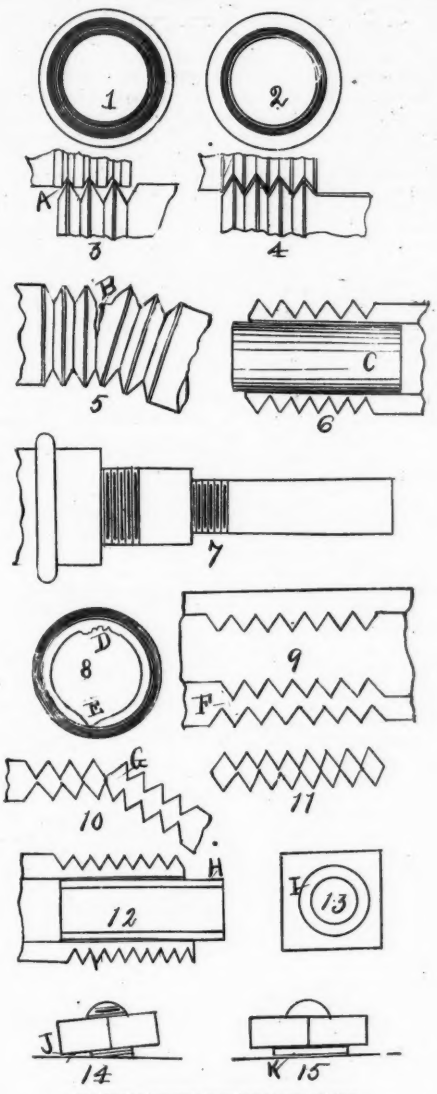

Some Defects Observed when Inspecting Gas Pipes.

which there are one or more reductions, for the reason that in reducing it is necessary frequently to thread the pipe on the inside as well as on the outside, as is illustrated at the joints which meet in Fig. 7. Again, in making reducing particular pains should be taken to have the threadwork all alike and very firm. No broken or shiftless work can be permitted to pass in reducing, even in one piece, and when two or more reductions are made the necessity for substantial threadwork is more evident.

Showing the Threads in Bad Shape.—In very many reduction systems in gas works and gas piping systems I have noticed excessive leakage and generally bad results due to a part of the thread being chipped out, as at *E*, Fig. 8, or stripped and broken, as at *D*, same Fig. This sort of thing cannot be tolerated in reducing systems, although it may pass in heavy piping connection in straight work. In Fig. 9 is shown at *F* why the threads should not only be very uniform in cut but should not be stripped or broken in any way. The threads cut for the outside, if run into the points of the threads cut for the inside, and broken in any form, very serious results may follow. Take, for example, the diagram, Fig. 10, in which it is shown how the pipe which is weakened will fracture itself at G. If the machinist who cuts the threads will plan it so that the tapping will be done in such way as to bring the seat of one system of threads between that of the other, then the metal will not be thinned down, and breakage is not so liable to occur at G, as in Fig. 10. This is further illustrated in example 11, in which it can be noticed that one set of threads from the interior runs almost into the set of the threads from the opposite side. This sort of work has been the direct means of causing numerous disasters in gas works and among gas apparatus and equipments relating to gas engines, as well as gas systems of pipes in houses, factories and public buildings in general.

To Plug or Strengthen a Weak Place of this Description.—It frequently happens that the inspecting officer, or perhaps the machinists themselves, will discover that there are some weak spots in a gas pipe system due to the defective cutting of threads on both sides of the pipe metal, and they may in season take steps to prevent accident by following the plan shown in Fig. 12. Here a section of a cut pipe is shown. It may be noticed that the threading is weakening the metal, in which case the interior threads should be entirely stripped off and the interior turned out so as to present room for the insertion of the additional piece of pipe *H*. This piece can be pinned or brazed into place, and then the new threads should be cut in this. It being thick and of good stock, a firm job can be done on it.

As to the Nuts of Securing Bolts.—Fastenings of bolts, bracket screws, etc., should be carefully inspected in gas pipe matters. It is a good idea to use bolts with a face or shoulder like *I*, Fig. 13, for when the jarring or straining of parts causes a nut to shift its position, as in Fig. 14, the one side, *J*, receives the strain and may become broken. This is overcome considerably if the shoulder plan is used, for then the center of the nut braces itself upon this place, as at *K*, Fig. 15, and sustains itself firmly.

The Cost of Coal in England.

By Mr. Norton H. Humphrys, in the *Journal of Gas Lighting.*

Four or five months ago, when the rise in price of coal became so marked as to create some feeling of alarm, many managers of gas works consoled themselves with the reflection that their contracts did not run out till Midsummer, and that the inevitable slump could not be staved off beyond that period. Unfortunately, the spring season found gas companies with very small stocks, and therefore purchasing much earlier than usual; thus stiffening an already strong market. And now, before the summer is well on, some collieries are already refusing to contract for forward supplies, and others will not entertain applications, not merely from fresh customers, but for any increase on last year's deliveries. We must go back to 1873 for anything like a parallel to the present position of affairs. Midsummer is well in sight, and brings with it the unwelcome conviction that there is something stronger to be encountered than a mere passing crisis, which can be covered by the undivided balance of profits or by a trifling dip into the reserve fund; and that we must, during the ensuing twelve months, be prepared to meet a coal bill of unprecedented proportions. From 25 to 50 per cent. on the price of coal means an item that, after everything possible in the way of reducing expenditure, increasing the returns of residuals, and so on, has been done, leaves a wide margin to be met, either by the accumulated funds or by a rise in the price of gas.

Nor are the majority of gas undertakings in a good position to meet such a heavy strain on their resources. Many struggled through the coal crisis of 1893 without asking their customers to share the burden. As a consequence, they found themselves a year or two later with a crippled reserve, and laboring under the state of things that invariably follows a starved repair and maintenance account; and in 1897, before they had time to pull themselves together, coals began to move up again. The prices of 1899, upon which the present rise is figured, were very appreciably—perhaps 10 per cent.—higher than those of 1896–7. The general rule has been to sell gas at the lowest remunerative price. As a result, the year 1899 found many who could barely hold their heads above water so far as earning full dividends is concerned; and even if the *status quo* had been maintained, they would be in a position calling for grave consideration.

So the question now pressing upon the minds of those responsible for the financial management of gas undertakings is: How is this increase of expenditure, amounting to some 10 per cent. of the total outlay, to be covered? Can any other items on the expenditure side be reduced, or can we do with a more modest balance available for pro-

fits? Turning to the income, can the returns from residuals be increased? Or must we, as a last resource, fall back upon a rise in the price of gas? It is not too much to say that the expenditure has already been carefully cut down to the lowest point. Starving the works, by avoiding painting and other necessary repairs, is simply borrowing from the future at a high rate of interest; and the same may be said of the policy of carefully shifting into the capital account every little item on behalf of which a plausible excuse may be found. Loading up the stock account with everything that can possibly be charged forward is equally reprehensible; and it is much better to show a plain, if unsatisfactory, statement than to trespass on the resources of the future, in order to compensate for the contingencies of the present.

But where is the inventor? Financiers do not want to be bothered with the new process man when times are good and dividends secure. He may lapse into a state of hibernation, or take his chance as a clerk or foreman, if willing to accept a little lower remuneration than the ordinary, in order to compensate for the fact that his fancy for experiment and research may lead to a little occasional neglect of routine duty. But when expenses threaten to encroach upon the balance available for profits, then the inventor is asked why he does not step into the gap. Why do you not deal with the transit of solid materials? Why do you not gasify the tar, and thus increase the yield? Why do you not make an incandescent mantle that can be retailed for 2d., and is strong enough to bear reasonable handling? These are the sort of questions that are put by impatient investors, who appear to regard the inventor as a modern "Slave of the Ring," capable of bringing out anything that they like to demand. The progress of our industry, as indicated by the reduction in the cost of manufacturing, purifying, and distributing gas, has been a record of steady work in the refinement and improvement of details, rather than one of startling innovations. The furnace, the retort, the condenser, and the purifier, have all been re-cast, from time to time, as increased experiences and resources of modern science may suggest. The generator furnace, the inclined retort, the charging and drawing machines, the conveyor of solid materials, and other advancements, have imperceptibly, but surely, established themselves. There had, however, been nothing of the striking or sensational character, of a kind likely to obtain a place in solid block type on the contents bills of our daily papers, or run the rounds of the Scientific Press; and at present there is no indication that the inventor is prepared to respond, to any important extent, to the demand for larger yields or cheaper working.

As regards reduction of dividends, the prospect is equally unpromising. A very large proportion of share capital has been bought at auction sales on terms that force the delusive prospect of a nominally high rate of dividend to give place to the plain reality of interest on the market value of money only. A substantial reduction of dividend would, therefore, inflict some loss and hardship in a quarter where they are not deserved, and would, in the end, recoil upon the undertaking itself, by depreciating the value of the shares. With regard to new capital, the price obtained would fall in proportion; and although the nominal rate of dividend would fall, the actual sum of money required, reckoned as a percentage on the paid up capital, would not be appreciably affected.

But then there are the residuals, supposed by many to be a veritable panacea for all the financial ills that may befall a gas undertaking. Time was when the income from residuals was a mere trifle. The coke was sold at a cheap rate; the tar and liquor were allowed to go into the nearest ditch; and the ashes, clinker, brick rubbish, etc., were given away. Under such prevalent circumstances, some go-ahead company or other, more far seeing than their *confrères*, started a retail coke trade, made tar pavement with the tar and ashes, used the ammoniacal liquor as a fertilizer, and by such means managed to make a sufficient sum out of the residuals to pay the dividends. The managers of those days had difficulties to contend with that we know nothing of, and obstacles to overcome which were even more important than the commercial value of residuals. Most companies would at the present time think it extraordinary if they could not make considerably more out of residuals than a sum sufficient to pay the maximum dividends; but at the early period under consideration, the idea of paying dividends out of residuals, and consequently selling gas at the bare cost, attracted a great deal of attention, and took popular root. The idea seems to have spread among a large portion of the public, that the capabilities of the residual market are equal, not only to the payment of dividends, but of everything else also; and that the income from gas is quite an incidental matter. Therefore, whatever the ideas of the coal master, the iron merchant, or the labor party (which is rather a different thing from the laborer himself) may be, the gas company are told in effect: "Pay it out of the residuals, and do not talk about raising the price of gas."

To what extent may the residuals be expected to respond to the heavy demand that may be put upon them? The need for their assistance is more pressing now than at any previous time; and anything that can be done to improve the residual market is worthy of careful attention. The principal residuals are coke, tar and ammonia; and besides these there are sulphur (as represented by the spent oxide), retort carbon, and cyanogen compounds. The only one that at all synchronizes with the price of coal is the first named—coke. It happens that dear coal usually means good trade all round, in which chemicals generally have their share; so that the prices obtainable for tar, sulphate, sulphur, carbon, etc., are likely to be better, and not worse. Concerted action has already been taken, and with a certain amount of success, in the matter of tar and sulphate; but it is remarkable that coke has been left to take care of itself, each gas undertaking doing that which is right in its own eyes as regards its disposal. Instances could be quoted showing that on occasions the scope of vision is closely limited by the circumstances connected with the current year's working, and fails to take in anything in the way of establishing a permanent improvement. But it is pertinent to ask whether something cannot be done for the price of coke. The state of the coal market is to an extent reflected in that of coke. Stocks are low, the supply is being reduced in proportion to the demand by the withdrawal of considerable quantities of coke for the manufacture of water gas—a sort of double-barrelled transaction that reduces the production of coke in proportion to the quantity of coal gas replaced, and at the same time makes an independent demand upon the coke-heap. Cannot the tactics which have made the best of a stiff coal market, from the coal factor's point of view, be repeated in the case of coke? The curse of the coke trade in the past has been the cheap job lot, brought by an outside contractor from a large center of production a distance of 50 or even 100 miles, and then sold at a price that forces the hand of the local gas company. What would be the position of the gas coal trade to-day, if there were cheap job lots of coal to be had? Surely the time is now ripe for the disposal of so-called "surplus" coke in a manner that will not injure and lower the tone of the trade generally.

It must not, however, be supposed that, even at the best, the residuals can be made to cover more than half the increased cost. Most gas companies make their contracts at midsummer, and for a year ahead, with the result that, if a rise in the market comes in the autumn, they are able to make hay while the sun shines, by getting better prices for coke during the remainder of their contract. But the thing cuts both ways; and in calculating the possibilities of the coke market during the ensuing twelve months, we must not overlook the effects of a possible fall in the price of steam and house coal, which will come sooner or later. If we have a mild winter, a substantial fall may be expected early in 1901, and would cause a corresponding reduction in the value of gas coke. With this reservation, it must be admitted that the present prospects of the coke trade are exceedingly good; and, as already remarked, the time is opportune for assisting it by the usual methods adopted for forcing or stiffening prices.

Any undertaking, however, that has been selling at bare cost—that is, including the statutory dividends as a part of the cost—will have to face the question of putting 3d. to 6d. on the price of gas, or else of taking a corresponding sum from the reserve. Whatever the decision may be, the position should be clearly explained to the public. The experience of those who bore the whole burden themselves in 1893, without asking their customers to help, was instructive, if unsatisfactory. To say they received no thanks is not enough. When the fall came in 1894, some expectation of a reduction in price was exhibited. The argument used was that, if the company could afford to sell gas at such and such a price while coal was at (say) 20s. per ton, they could afford to sell it at a great deal cheaper when coal had fallen to 15s. The managers of gas undertakings may, if they choose, struggle along at the old prices, and no notice will be taken; but if a fall of some shillings per ton in coal should occur, the old argument will come up again, and there will be a demand, or at least an expectation, of a reduction in the price of gas.

A great deal of importance has—and very rightly—been attached to "cheap" gas; but it is notorious that the rage for cheapness has in many trades been carried too far. Our prisons, workhouses, asylums, and hospitals could together make up a casualty list, composed of downtrodden toilers, ruined and bankrupt tradesmen, underpaid assistants, and so on, equal in extent to the terrible casualty list which

is one of the prices of our successes in South Africa. It is also possible to carry the desire for "cheap" gas to an extreme. There is much in the remark made by an American gas engineer to the effect that in one town where the gas is sold at 5s. per 1,000 cubic feet the public may be more satisfied than in another where it is sold at 3s. 4d., because, in the first case, not only is care taken that the supply should be unexceptionable in quality and quantity, but the consumers have been carefully educated in the matter of using gas to the best advantage. The company not only take care that every consumer should know where and how to get the latest and best advice as to the proper methods of utilizing gas, but that they should be able to obtain the proper appliances put up ready for use on reasonable, if not liberal, terms. The second company have only one idea, and that is to cut down expenses. The overworked and badly paid staff have no inclination—even if they had the time—to give advice to the consumers. They are so pinched in the matter of retort and gasholder capacity, that their full attention is necessary in order to keep up a proper supply; and at the best they cannot avoid an occasional reduction of pressure, bad quality, or imperfectly purified gas. The broad result is that the public, left to themselves, use old fashioned uneconomical appliances; and although the gas is cheap, they are always complaining of heavy bills. It is possible, by educating the gas consumer, to reduce the gas bills, although the cost per 1,000 cubic feet remains the same; and of the two, there are obvious reasons why a reduction in the quantity consumed is more likely to give satisfaction, and lead to increased business, than a reduction in price. And if gas consumers are to be supplied at the lowest possible price, that price must of necessity be a fluctuating one, and it must rise as well as fall. If a rise is considered to be objectionable in any way, or a serious injury to the business, the only way is to exercise caution in the matter of reduction, and maintain a large reserve or balance of profits in hand.

There may be reasons against raising the price; but at this juncture there are others in favor of such a course. The price of coal is a fact that is patent to everybody; and an announcement that, in consequence of the increased cost of coal, it is necessary to raise the price of gas (but that it is hoped that the advance will be merely a temporary one), should not arouse opposition from ordinary fair minded and reasonable men, who would accept it as a rational step, and indeed would be inclined to be suspicious, and to imagine that the shareholders had some shuffling and underhanded method of taking care of themselves, if the rise did not take place. In any case, there is no real or lasting advantage to be gained by postponing the erection of really necessary extensions, by cutting down the staff, or by other heroic attempts to reduce expenses, and thus avoid the necessity for increasing the price, even at some sacrifice of efficiency. It is necessary, or at least desirable, that the gas supply should be cheap; but it is even more important that it should be unexceptionable as to quality, quantity and purity.

The Design of Steam Power Plants, No. 1.

By Mr. H. C. Myer, Jr., in *Engineering Record.*

Introduction.—No better service can be done the non-expert about to construct a steam plant than to advise him to engage at the outset of the project some capable engineer to design the plant and superintend its installation. In spite of the advantages of having work planned and carried out by such men, it will always be, probably, that a very considerable proportion of the work done will be constructed for one reason or another, by persons with a semi-technical training without the aid of the expert engineer. It is, therefore, proposed in this and in following articles to give data and information which, it is hoped, will aid the engineer who cannot be called an expert in selecting the various kinds of machinery and apparatus that make up a steam power plant, to discuss specifications for these in a general way, and to outline the manner in which they should be purchased.

It is the practice of many engineers in steam plant construction to invite bids on apparatus described very generally in a specification and intended to perform a service under conditions that are named, the idea of the engineer being to allow each bidder to proportion the parts of the apparatus he is to furnish and to quote a price on it. When bids are received under these conditions, it generally follows that there is a variation in the size of the machinery offered by different makers to do the same work, and the lowest in price may not be best adapted for the conditions. An engine, boiler or pump, in fact almost everything about a steam plant, may do the work required of it, but it may be so proportioned as to do it in a manner that is not best for the owner. For instance, while an engine may give the required power, its cylinders may be so small that it requires an excessively large amount of steam to run it, or a boiler may be so small that an abnormal amount of coal must be burned in order to generate the steam required. The expert engineer is, of course, able to detect and reject bids on deficient apparatus, yet when the size of the apparatus is fixed by the contractor it may happen that the purchaser, who is not an expert, will accept machinery which is not best adapted for the service that it is to perform, particularly if the too frequent custom of purchasing the apparatus lowest in price is followed.

There are other methods of buying apparatus for a steam plant. One is to go to a reputable manufacturer or contracting engineer and engage him to build the machinery wanted and pay what is asked for it. Such a contractor should not, however, be placed in competition with others if he is to design a plant to fill the requirements of the owner, for if this is done the contractor's interest is to design a cheaper plant than will be proposed by his competitor, whose bid is based on the plant designed by him, and this kind of competition sometimes results in inferior apparatus being supplied.

Another method of purchasing is to have the engineer state in his specification the dimensions of the apparatus wanted, permitting, however, a departure from these specified dimensions in order that a manufacturer can make use of his standard patterns, provided such a course is not detrimental to the purchaser's interest. When all manufacturers bid on the same basis their bids are lower and the purchaser is sure of getting a properly proportioned machine, provided the engineer who prepares the plans and specifications is capable. Many believe the last two methods of procedure much preferable to the first. Latitude given an imprudent contractor, in the way of fixing the dimensions of the apparatus he is to supply, may, in a measure, be covered by demanding a guarantee as to efficiency, yet tests necessary to determine if the guarantees are fulfilled are expensive and are therefore generally omitted.

Location of Plant.—One of the first questions to be decided in the construction of a power plant is its location. This depends on several factors, the most important of which are, the ease with which the power may be transmitted from the generating source to the locations of the demand, the cost of delivering coal and removing ashes from the power house, and the availability of a supply of water for condensing purposes.

The first factor, the ease with which power may be transmitted from the generating source to the machines utilizing it, is the one that frequently decides whether an electric or belt and shafting system of transmission is to be used. It is, of course, impossible to give any general rule applicable to all cases, as each situation demands a thorough investigation of the cost of installing and operating both plants. In arriving at their relative costs of operation, the interest on the investments, the repairs, the fuel cost, the cost of attendance, supplies, etc., have to be reckoned. Generally speaking, it may be said that in any situation where the load on the power plant is practically constant throughout the working day, as in a textile mill, and where the power house may be located close to the lines of shafting so that belts may be carried from the engine to the shafting without the use of gearing, quarter turn belts, etc., the belt and shafting system of transmission seems the most favored. If, however, the manufacturing establishment consists of a number of separate buildings in which lines of shafting are at different angles, so as to require several separate power plants or else a complicated system of belts or gears, the electric system possesses advantages as regards cost of operation that makes its adoption advisable. Again, the tendency in establishments where the work is similar to that of a large machine or bridge shop, where the tools are used intermittently, where one or two departments may run overtime, the electric system seems to be gaining friends. The reason for this is not the difference in the operating expenses, which are slight, inasmuch as a machine shop requires a very small amount of power for its operation, but in the greater convenience and cleanliness of the electric system. One solution of the problem of transmitting power when shafts lie in directions that are not parallel is the rope drive. This has been used with the greatest success in many plants. Its low first cost and cost of repairs and the flexibility of the system make it well worth considering in many installations.

The cost of handling coal and removing ashes in a power house may be a considerable item in the operating expenses, and large plants are therefore usually equipped with coal handling machinery. Some steam plants are so arranged that railway cars or coal carts may be run over a receiving hopper from which the coal is conveyed mechanically to storage bunkers over the boilers and chuted from the bunkers to the furnace by gravity. If a plant is not to be provided with coal handling

machinery, it is well, if convenient, to provide a trestle so that cars may be run over and dump into a bunker opposite the furnace doors in order that the coal may fall by gravity through holes in the wall separating the bunker from the boiler room on to the floor of the latter in front of the furnace doors.

The value of water in sufficient quantity to condense the steam exhausted by the engines often determines the location of the power house. From 15 to 20 per cent. of the fuel used by a non-condensing engine will be saved if it is operated with a condenser. Each pound of steam exhausted by an engine requires a supply of 30 to 35 pounds of water for the condenser, so it will be seen that the water needed for condensing purposes is often a considerable quantity. Sometimes when a power house cannot be located on the bank of a stream from which a supply for this purpose is available, a pipe or conduit can be laid from a river to a well near the power house, the grade of the conduit being below that of minimum low water. The injection pipe, as the pipe that conveys the water to the condenser is called, can then be run from this well to the condenser, which is usually located close to the engine Because of the vacuum in the condenser, the water will rise in the injection pipe from a lower level to the condenser. It is not advisable, however, to attempt to lift the injection water over 22 feet. Where the lift would be slightly greater than this the condenser can be placed in a pit. Since the development of the cooling tower, an apparatus for cooling condensing water so that it can be used over and over again, condensing plants are not so dependent on an abundant water supply, as they were before this apparatus was perfected, and hence the importance of locating a plant by a stream for condensing purposes is not as great as it was once.

Drawings.—Complete and accurate drawings of all of the details of a steam plant are a necessity. It is well to make assembled drawings showing the plant in plan and as many elevations as may be necessary to make the arrangement clear. Assembled drawings insure all parts of the plant fitting together properly, and prevent mistakes such as attempting to run steam pipes where a building column ought to be, and so on. If assembled drawings are to be made, the scale assumed should be sufficiently large to show the steam pipe system. Three-eighths of an inch to the foot is about as small as can well be used. As soon as contracts are made for engine, boilers, feed-water heaters, pumps, etc., accurately dimensioned blue-prints showing the machinery in plan and elevation should be obtained from the contractors. Experience has shown that it is well, with some firms at least, in order to avoid delay, to get these blue-prints before the contracts are let. Contracts for the building, steel work, etc., should not be made until the machinery is contracted for, since it may not be possible to obtain the machinery which was contemplated at the time the building plans were made, and machinery then available may not fit. It is, of course, essential that the building be fitted to the machinery, not the machinery fitted to the building.

Type of Power House.—Generally the relative location of the engine and boiler rooms is determined by some local condition. Where it can be done, however, it is better to locate the engine and boilers in one building, with a wall between them, and to place them in parallel rows with the cylinders of the engine adjacent to the rear of the boilers. This is particularly the best arrangement if the plant is likely to be enlarged in the future. The steam pipe connecting the boiler and engine or engines is the most direct in this arrangement, and it can be most readily enlarged. If the engine and boiler houses are placed end to end and contain two or more boilers supplying one engine, the proper size of piping for such a plant will be inadequate if another engine is added at one end of the plant and more boilers installed at the other.

Where land is very expensive, boilers are sometimes placed in buildings with two or more floors. Ordinarily, however, the boiler room floor is usually on the level with the outside ground, while the engine room floor with large engines is invariably higher, usually from 6 to 12 feet, depending on the height of the engine foundations. Sometimes an engine is installed where the engine room floor is on the ground level. When this is done, it is necessary to construct a pit for the condenser, if such an auxiliary is used, also pipe trenches and, if the engine is a large one, a pit for the fly-wheel. It perhaps ought to be stated at this time that a condenser ought always to be below the engine, as the pipe leading to the condenser cannot rise at any point without introducing a dangerous element into the power plant. The arrangement that necessitates the construction of pits ought to be avoided, if it is possible, as it is difficult to construct a water-tight pit for the fly-wheel and condenser, because the vibration of the engine is apt to crack the lining of the pit and allow water to enter, if there is any in the soil. The trenches for the exhaust piping have to be covered and the piping is not nearly so accessible when in a covered trench as it is when in the basement usually provided under engine rooms.

Building.—A building for a power house should, if possible, be constructed of fireproof materials. Brick walls with steel trusses supporting a wooden roof covered with tar and gravel, or with some form of fireproof construction, is the usual construction. The brick walls sometimes carry the roof trusses and tracks for traveling cranes, and again these are supported by steel columns resting on the foundations and imbedded in the brick walls, the latter, however, carrying only their own weight. The building should be designed by an architect or structural engineer. The construction of the building can be done by bridge shops making a specialty of constructing buildings of this character and supplying the steelwork for them.

The buildings should be of such a size that the machinery in them is not cramped. When there are several machines in an engine room it should be remembered when locating them that it is sometimes necessary to stop a machine very quickly. It is well, therefore, to place all machinery in such a position that it is readily accessible to the man or men in charge of it. Provision should be made in planning and constructing a power house for bringing the machinery into the building after it is erected, and a door of sufficient size to admit the largest part of a machine must be provided. Ample room must be left around the horizontal steam and water cylinders to be able to remove piston rods if it should be necessary, without removing the cylinder from its foundations. Enough space must be left between the foundations of adjacent engines and between foundations and engine room walls to allow a man to get between them to reach the foundation bolts. In a boiler room, there must be a clear space in front of the boilers at least as wide as the boiler tubes are long. The distance between the rear of the boilers and the wall need not be greater than 5 or 6 feet, or enough to allow a wheelbarrow to be placed opposite the soot door in the rear of the boiler setting, if such a door is provided.

Foundations.—The character of the soil underlying the site for a power house should be carefully examined in order that the foundations can be so planned as to keep the load imposed by the buildings and machinery within the safe limit. For ordinary one story buildings where the loads are not excessive, holes should be dug at numerous points over the site and the character of the soil determined. As the magnitude of the work increases more care should be taken. In important work a competent specialist in foundation work should be consulted. As to the bearing capacity of different soils, the New York Building Code states: "Different soils, excluding mud, at the bottom of the footings shall be deemed to safely sustain the following loads to the superficial foot, namely: Soft clay, one ton per square foot; ordinary clay and sand together, in layers, wet and springy, two tons per square foot; loam, clay or fine sand, firm and dry, three tons per square foot; very firm, coarse sand, stiff gravel or hard clay, four tons per square foot."

If loose rock is found it should be removed, solid rock should be dressed off in steps with vertical risers and horizontal treads so that the pressure will be exerted everywhere in a vertical direction. Solid rock will stand almost any load that can be imposed upon it. If soil of low bearing power is found, piling is usually resorted to. Piles may be of spruce or hemlock at least 5 inches in diameter at the point and 10 inches in diameter at the butt for piles 20 feet or less in length, and 6 inches at the point and 12 inches at the butt for piles over 20 feet in length. The bearing power of piles not driven to rock or hardpan or similar firm material may be calculated by the Wellington formula, in which the safe bearing power in tons is equal to twice the weight of the hammer in tons multiplied by the height of the fall in feet divided by one plus the penetration of pile under the last blow in inches. From a knowledge of the total load to be carried and the load that each pile will support, the number of piles necessary under a weight to be supported can be calculated. If the soil is not firm, the bearing power of a pile should be taken much less than that given by the formula, in order to allow for decrease in strength due to vibrations of the machinery. To avoid decay the piles should be cut off at the level of the ground water or not more than 1 foot above it.

It is getting to be the practice in power house construction where piles are used to saw off the heads of the piles to a uniform grade, then excavate the materials between the heads of the piles for a depth of a foot or so and lay a bed of concrete sometimes several feet in thickness between the heads of the piles and over their tops. An 8-foot bed of concrete over piles on 30-inch centers was used on a foundation for the 96th street power house of the Metropolitan Street Railway Company

in New York city. If the soil underlying a power house site is found to possess too low a bearing power for the foundations of the engines and boilers to be constructed directly on it, concrete beds may be laid so as to distribute the load. Sometimes a concrete bed is laid under the engine foundations and another under the boilers. Again the entire site is covered with a bed of concrete and the wall footings and machinery foundations built directly upon it.

Engine Foundations.—These are almost invariably constructed by the owner, the engine builder furnishing the drawings. The latter generally consist of accurately dimensioned drawings showing the foundations in plan and one or two elevations and also a drawing of a board template which has to be made for locating the foundation bolts. A hole is bored in the template where each bolt is located, and the template is supported over the place where the foundation is to be constructed, at such a height that the foundation bolts may be suspended in the position that they will finally occupy, by passing them through the holes in the template, the nut on the upper end holding them in position. The foundation is then built around the bolts, leaving holes about them an inch or two greater in diameter than the bolts themselves, so that the latter may be moved slightly, to pass through the holes in the engine bed plate, should an error occur in locating the position of the bolts or the holes in the engine bed.

Foundations for engines are sometimes constructed on a very thick bed of concrete, as has been explained. This is not always necessary, and where good loam and clay are known to exist for some distance below the surface of the ground, the earth may be leveled off and the foundation commenced on a layer of concrete just thick enough to give a good bearing. If loose rock or poor earth is found, this should be removed and the excavation filled with concrete, in which loose stones, old bricks, etc., may be imbedded, care being taken to put them in layers alternating with the concrete, which should be so placed and rammed as to make sure that there are no voids. This should be continued up to the level at which the regular brick or concrete foundations are to commence. There seems to be no good reason for using a pure concrete bed if the earth is of good quality and the load imposed upon not excessive. Engine foundations should be of brick laid in cement mortar made of one part Portland cement to two parts clean sharp sand or of concrete. Good concrete is obtained by mixing one part good Portland cement, two parts sand and four parts broken stone, the latter small enough to pass through a 2-inch ring. Concrete should be laid in layers not over 6 inches thick, each layer being thoroughly rammed before the one above is put down. Such a foundation has to be surrounded with board walls or forms to suitably hold the concrete while it is being laid. A Portland cement concrete foundation ought to stand at least two months, and one of brick in Portland cement one month before it is loaded, whenever possible to spare the time, but if suitably proportioned and carefully watched it can be safely loaded much sooner, especially if the concrete is made as dry as possible.

(To be Continued.)

A Burette for Accurate Gas Analysis.[1]

[By Mr. ALFRED H. WHITE, University of Michigan.]

Everyone who has attempted to make accurate analyses of gases with the usual Hempel apparatus for technical gas analysis, knows there are many unavoidable sources of error, slight in themselves, but enough to make an exasperatingly large total at the end of a long analysis. The apparatus to be described was devised in the effort to eliminate some of these sources of inaccuracy. It is a modification of the Hempel burette with Petterson correction tube, the alterations being in the design of stop-cock and the position and form of the manometer, besides a change in the shape of the graduated tube to permit a more accurate reading of the gas volume. It has been used in its present form for the past year in this laboratory, and has been found to fulfill its purpose.

Some of the errors incident to analyses as usually conducted may be avoided by well known precautions. If mercury instead of water is used as the liquid in the burette, errors due to solubility of the gas in the burette liquid, and errors in reading due to water adhering to the walls of the burette, vanish. Errors due to solubility of gas in the reagent of the absortion pipette may be minimized by the use of a small quantity of the reagent in a pipette otherwise filled with mercury and may be greatly lessened when using an ordinary pipette by saturating the absorbing liquid with gas like that to be analyzed. Errors due to diffusion of gas through the liquid in the pipette are much more important than is usually believed, but may be obviated for most reagents by the use of a few cubic centimeters of mercury, forming a trap at the bottom of the pipette. The errors which this paper aims to discuss and in part to remedy are those due to: Change in temperature and barometric pressure during an analysis; inclusion of air or leakage of gas while making connection with pipettes; and inaccuracy in reading gas volume.

Gas burettes in which the gas volume is unaffected by change of temperature and pressure have been devised and are well known. The Petterson correction tube as modified by Hempel, Drehschmidt, and others, consists of a glass tube of about the same dimensions as the burette, sealed at its lower end and with its upper end connected to one arm of a manometer whose other arm connects through a three-way stop cock with the gas burette. This correction tube is enclosed in the same water jacket as the burette, and hence the gas volume in it is affected by changes of temperature to just the same extent as the gas in the burette. When the liquid stands at the same height in both arms of the manometer, the pressure in the burette is the same as in the correction tube and therefore a constant, as the correction tube is sealed at its lower end. If the gas volume is read under these conditions it will be independent of changes in external temperature and pressure. There are several objections to the Hempel form of apparatus. The two rubber connections of the manometer may allow leakage of gas and consequent change in the supposedly constant pressure of the correction tube. Second, in drawing the gas out of the manometer into the burette there is a pronounced tendency on the part of the column of liquid to break when it starts down hill, especially at the rubber connection, with the result that some of it becomes carried into the burette with consequent change in the pressure indicated by the manometer. Figs. 1 and 2 show the arrangement designed to overcome this difficulty. There is but one rubber connection in the manometer, and that is placed so that only mercury and never gas is brought in contact with it, thus rendering a leak with consequent change in pressure of the correction tube impossible. Communication with the manometer is established by turning stop cock to position in Fig. 4. By placing the manometer below the stop cock the further advantage is gained that in drawing the gas out of the manometer the mercury travels but a short distance and up hill only, meets with no bends or inequalities in the tubing, and so may be drawn with great exactness

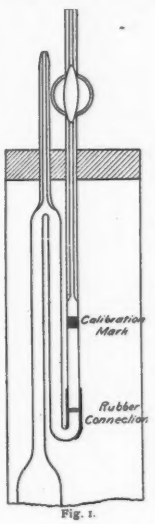

Fig. 1.

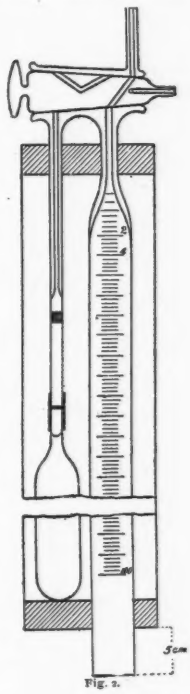

Fig. 2.

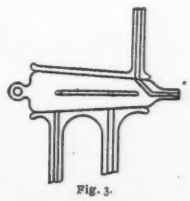
Fig. 3.

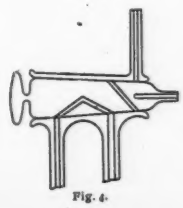
Fig. 4.

1. *Journal American Chemical Society.*

to the stopcock, drawing out all the gas without losing any of the mercury. The apparatus is all enclosed in the water jacket and therefore all the same temperature, and is less cumbrous and apt to get broken than in other forms. The capillary tube projecting into the air behind the stopcock, as shown in Fig. 1, is to be sealed, under observed barometric pressure if desired, when the apparatus is first set up. The gas volume may be read when the mercury is at the same height in the two arms of the manometer and may then be reduced to standard conditions if desired. When this is not required, it is much more accurate to bring the mercury to a mark etched on the glass, or better tangent to the lower edge of a black metallic collar cemented around the manometer tube. In this case the gas will not be under the same pressure as that in the correction tube, but the variation will be a constant one and will cause no error. The connection between the burette and pipette is, as usual, made by a bent capillary tube and two rubber connections. Rubber connections, if properly made, introduce no appreciable error, but, because of their tendency to leak, form a serious menace to accuracy. Unfortunately no way has been found to dispense with them, and they are accepted by the author as a necessary evil. There is, however, an inherent source of error in the usual method of making the connection which the burette here presented completely obviates. With the apparatus ordinarily used, some of the gas under analysis will escape, or some unmeasured volume of air will be admitted to it whenever a connection is made. Perhaps usually both happen. The capillary tip of the burette, the connecting capillary and the capillary tip of the absorption pipette have a combined volume of about 0.5 cc. Although by various manipulative devices it is possible to restrict the error thus introduced from any individual operation to a fraction of this volume, it amounts in the course of a long analysis to a serious total. In the burette here presented it is completely eliminated.

By referring to Fig. 3 the stopcock is shown turned in such a way that there is a clear passage from the capillary exit tube of the burette through the stopcock to the outer air again. With the stopcock in this position the pipette is to be connected in the customary way to the burette but without any of the usual precautions to prevent inclusion of air. The liquid in the pipette is now blown up and through the capillary till it reaches the stopcock. The capillary tube is thus completely filled with liquid. By turning the stopcock to the position shown in Fig. 2 communication is established between the burette and pipette, and the gas may be passed over and absorbed as usual. After the absorption it is drawn over till the pipette liquid just reaches the stopcock, which is then turned back to the position in Fig. 3, allowing the liquid in the capillary of its own accord to siphon back into the pipette. The capillary is then to be rinsed out with a wash bottle. In this way all the gas is each time drawn back into the burette for measurement. There is no gas lost in the capillary connecting tube, and no air is introduced, if the rubber connections have been properly made.

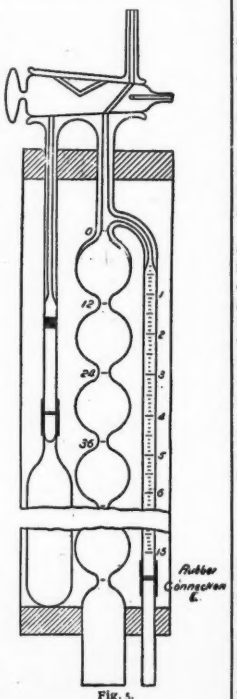

Fig. 3.

The gas volume in an ordinary gas burette may read with grest accuracy with the assistance of a telescope, or some similar help, but it was desired to render such an adjunct unnecessary. The suggestion was taken from one of Bleier's[1] sketches. Fig. 5 shows schematically a gas burette with stopcock and manometer as already described. The main body of the burette contains 12 bulbs, each of a capacity approximating 12 cc. A line is etched on each constriction and the capacity of the bulb between these marks is determined. Starting from the capillary above the top bulb a side arm springs, terminating in a small burette with total capacity of 15 cc. and graduated in 0.1 cc. Both these burette tubes connect at the bottom by means of heavy rubber tubes and a Y with a stop cock on each arm, to a common leveling bottle. A screw clamp on each rubber tube serves for the exact adjustment of the mercury. To measure a gas, the stopcock is placed in position in Fig. 3 and the mercury in the bulbed tube brought to the mark in one of the constricted portions by opening the proper stop-cock on the Y and raising or lowering the leveling bottle. When adjusted, the mercury is held in its proper position by closing the stop-cock on the Y. The stop-cock leading to the small burette tube is then opened and the gas brought to approximately atmospheric pressure by proper change in the mercury level. The three-way stopcock at the top of the burette tube being now turned to position in Fig. 4, the burette is brought into connection with the manometer, which is properly set by further changing the level of the mercury in the small burette. The final adjustment in both burettes is made by the screw clamps on the rubber tubes. The volume of the gas will be read as x cc. in the bulbs + y cc. in side burette + z cc. in manometer. As there are these three readings to be made it is necessary that each be very accurate. Let us see how accurately this may be done. First, the mercury in the bulbed tube is to be brought to a specified mark in a tube of about 5 mm. internal diameter. By means of the screw clamp this may be done with such accuracy that the error is negligible. Second, the volume of gas in the side tube must be read. Each 0.1 cc. in this tube occupies a space of a little over 2.5 mm. and it is possible to interpolate 0.01 cc. with the eye with an error of less than 0.02 cc. Third, the mercury in the manometer must be brought to a definite mark with such exactness that the barometric pressure, under which the gas volume is read, shall be almost identical each time. A difference of 1 mm. of mercury pressure changes the gas volume 0.13 per cent., which on a volume of 100 cc. equals 0.13 cc., an error far too large. It was found impracticable to attain the required accuracy when it was attempted to bring the mercury to a mark etched on the glass. The best device was found to be a band of thin, blackened copper, wrapped around the tube and cemented to the glass. It is possible to bring the mercury tangent to the lower surface of this with great exactness. In working with this burette the author is accustomed to make all readings in duplicate, readjusting at all points each time, and to repeat if the two differ from each other by more than 0.01 cc. Duplicates usually agree within this limit. The greatest difficulty found in manipulation is to draw the liquid from the pipette over exactly to the burette stop cock and stop it there. If it gets into the burette, a bubble lodging in one of the capillary tubes frequently damps the sensitiveness of the manometer. If this happens the bubble may be shot out of its lodging place by compressing the rubber tube above the screw clamp. Such a bubble may also be carried into the manometer, where it will obscure the surface of the meniscus. To remedy this it is well to keep 2 or 3 mm. of water on the surface of the mercury in the manometer. This allows a perfectly sharp reading of the mercury meniscus below the water-level. The manometer should respond to a very slight movement of the screw clamp.

The advantages of this burette may be summarized as follows: It is a compact burette which, without reading-telescope or other accessories, allows the volume to be read with an error of less than 0.02 cc., compensates automatically for changes of temperature and pressure, and avoids completely all errors due to inclusion of air or loss of gas in making connections with the absorption pipettes. The disadvantages so far developed are chiefly those inherent in all forms of apparatus which possess a stop cock and rubber connections. Both may leak; but on the other hand both may be kept so tight for limited periods of time as to introduce no measurable error.

Accurate apparatus is essential for accurate work and the author feels it but a just acknowledgment to thank Messrs. Greiner and Friedrichs for the care and skill with which they manufactured the burettes from his sketches.

1. C. Bleier, "Ueber Gasometrische Apparate." *Ber. d. Chem. Ges.* 31, I., 288.

The Production of Sulphur in England.[1]

In view of the fact that the Anglo Sicilian Sulphur Company is within measurable distance of its determination, as far as the 5 years' working arrangement is concerned, speculation is somewhat rife as to the move which the directors may take in the way of continuing it. It is not our intention here to make any conjectures on the subject; but it may not be without interest, however, to enlarge on one or two points prominently connected with the inception of the Company; and we hardly think that any apology is needed for doing so, as the main *raison d'être* of the Company has not, to the best of our knowledge, been clearly indicated in the press. No doubt the over-production of

1. From *Engineering*.

the Sicilian mines a few years ago had tended to bring prices down to an unremunerative level, and no doubt the lot of the miner was miserable in the extreme; but these were facts which the consumers of the sulphur did not allow themselves to be distressed by, and there hardly seemed any reason why Englishmen should exert themselves to put matters on a better business footing.

The question why, then, did certain prominent Englishmen bestir themselves in the matter may naturally be asked, and we at once make reply they did it for the very good reason of self-interest, England having become a producer of brimstone. The expense of the production of the brimstone, however, was such that the process could not compete successfully with the native Sicilian product, so the scheme of consolidating the interests of the rival producers was evolved, and took definite root in the formation of a "ring," under the name of the Anglo-Sicilian Sulphur Company, which now controls practically all the sulphur used in England. Now, although this concern may seem to have cornered the sulphur market to the detriment of the consumer, and may thus appear to deserve the censure of those people—and they are not a few—who are strenuously opposed to any such combination in trade, to our mind it presents itself in quite a favorable light, and for two main reasons. It has rendered it possible, by regulating the output, for mining operations to be carried on in Sicily much more to the benefit of the miners than was formerly the case; and secondly, by fostering the production of sulphur in England, it has prevented the accumulation of those unsightly heaps of alkali waste which were in former years a source of annoyance, if not of actual danger, to the dwellers in the vicinity of the alkali works. This recovery of sulphur, amounting to about 40,000 tons per annum, could not have been profitably effected if the value of the article had remained at the low level to which it had sunk in 1895, and after the expenditure of a large amount of capital an abandonment of the process would have been necessary, as was the case at an earlier period in the history of sulphur recovery systems.

It is the Chance-Claus process of sulphur recovery which now holds the field, and which, by reason of its superiority, has caused the abandonment of the formerly worked processes of Mond and of Schaffner. As in many other important chemical processes, the success which has been attained by Messrs. Chance & Claus was due more to the perfecting of method than to theoretical considerations, because Gossage, fifty pears ago, proposed the chemical reaction which Chance worked out successfully; and it is probable that Gossage would have reaped more benefit from his expenditure of £10,000 over his process, if some sort of an arrangement had existed by which the price of sulphur was maintained. However, not to spend time on matters of history, we proceed to say that the Chance-Claus process is now in operation on the large scale at many of the works of the United Alkali Company, a notable plant for its size and engineering arrangements being that of the Gateshead works of the Company just mentioned, and which belonged to the Allhusens before the great chemical combine was brought about.

We will attempt a brief description of the process as worked, though we are aware that it is at all times a matter of some difficulty to make a synopsis of a chemical process clear to the uninitiated without the aid of drawings. The alkali waste, which is the residue from the manufacture of sodium carbonate from common salt by the Leblanc process, consists practically of calcium sulphide, a body which has the objectionable tendency to decompose, when moist, into sulphur compounds seven times worse than itself, of which it is sufficient to particularize sulphuretted hydrogen gas. In the process under description, this waste is ground up fine, and made into an emulsion with water in large iron vessels provided with mechanical stirrers. This emulsion then passes into a series of cast iron cylinders, called carbonators, into which carbonic acid is pumped, the result being the production of calcium carbonate and sulphuretted hydrogen. The carbonic acid is produced by burning limestone with coke in a special German type of kiln, in which the gas can be produced practically free from oxygen; a matter of the greatest importance, and the attainment of which in the present case has been easily brought about by adoption of the kiln used by Messrs. Brunner, Mond & Co., in the ammonia soda manufacture. The chief impurity of the gas is dust, and this is removed during its passage through water and air condensers, in order to cool it to a temperature which will not damage the compression pumps. To return to the sulphuretted hydrogen produced in the carbonators; this is drawn off to a gasholder of the ordinary type, but luted with coal tar oil instead of water. From here the sulphur gas passes to the Claus kiln, where it is mixed with the theoretical quantity of air required to produce the equation sulphuretted hydrogen + oxygen = water + free sulphur. The kiln contains layers of ferric oxide, and when the combustion of gas and air has once commenced, the heat generated by the reaction is sufficient to keep the process going on. From this kiln the sulphur runs off, partly as brimstone, the remainder going into a chamber a little distance off, where it condenses as flowers of sulphur.

The success of the process depends upon the gas and air being in the correct proportions, and where this is so the operation goes on steadily and continuously, and with a minimum of supervision or labor. In fact, to those who are accustomed to judge the importance of a factory by the number of hands engaged, there is a somewhat ghostly air of desertion about the extensive series of kilns in operation at Allhusens' Works, so rarely is a workman seen; but it would be very erroneous, indeed, for the casual visitor to suppose that the manufacture of sulphur is proceeding on but a trifling scale. The fact is that once the Claus kiln is started, it works automatically, and requires but a minimum of attention, a remark which applies in a lesser degree to the whole sulphur recovery process. At the works just mentioned, the large volume of 3,500,000 cubic feet of gas is dealt with every 24 hours, a statement which renders it almost unnecessary to say that the plant covers many acres. This brief description will suffice for those who are not particularly interested in the subject, but who are not altogether averse from learning a little about matters which may not seem to have any direct bearing upon their regular business.

A word or two as to the sulphur itself; it was thought at first that this could not compete with the best qualities of Sicilian because, although it was over 99 per cent. purity, it contained traces of that disagreeably smelling body, persulphide of hydrogen. This difficulty has now, however, been overcome, and the brimstone and flowers of sulphur produced by the United Alkali Company can rank with the best of imported brands. With regard to the economy of the process it is a distinct advance on those of older date, as 90 per cent, of the total sulphur in the alkali waste is recovered; at least this is what has been proved possible, though whether this efficiency is always maintained is a matter on which we are not prepared to be dogmatic. Where gases are dealt with there is always a certain loss due to leakage, though this in the present case is, owing to the vigilance of the alkali inspectors, of very trifling amount. At first there was some genuine ground for complaint, especially on account of the waste gases escaping from the Claus kiln; but the improvements which have been effected have rendered any annoyance quite infinitesimal.

The use of the Claus kiln, it may be said, is not confined to alkali works, for within the last few years it has been applied to works where sulphate of ammonia is manufactured from gas liquor, such works also being under the surveillance of the alkali inspector. In this manufacture the gas liquor is distilled with lime, the free ammonia gas and H_2S passing into a saturator containing sulphuric acid where the sulphate is formed. The sulphuretted hydrogen evolved from impurities in the ammonia liquor would contaminate the atmosphere unless some means were provided to deal with it. Hitherto the sulphuretted hydrogen was passed into purifiers containing oxide of iron or bog ore, where the sulphur was absorbed, but this method is rapidly being superseded by the sulphur kilns, which, though more expensive in the prime cost, greatly reduce the working expenses, and also producing a useful commercial product, viz., sulphur.

To revert once more to the matter of the Anglo-Sicilian Company, mention may be made of the fact that the invasion of our markets by sulphur from countries other than Italy has not come to pass, though it was confidently predicted that the rise in price would render this not only possible but probable. Japan certainly has increased her export of late years to the respectable total of about 15,000 tons, but there are difficulties about freight charges which militate against her chances of becoming a formidable competitor. The Japanese exports go mostly to the United States, though seeing that of the 350,000 tons which Sicily annually exports, nearly one half goes to the States, the Sicilians cannot, so far, have been much affected by the growth of the Japanese exports. With regard to the production of sulphur in the States, matters are still in a transition stage. The deposits which have been worked are in inaccessible regions of the West, and the total annual yield has not exceeded 2,000 tons.

Considerable interest attaches to the process of Mr. Frasch, which has been under trial at Sulphur City in southwestern Louisiana, and which consists in melting the sulphur underground by hot water and then pumping it to the surface; but we are not in a position to give any details as to the success attained, though an American writer has expressed his regret at the serious effect the process must eventually have upon the fortunes of the Sicilian miner. No doubt, if the Anglo-Sicilian Company had sought to make exorbitant profits out of the sale of the product under their control, it would have given a decided fillip to

the exploiting of sulphur deposits in other lands; but as they have been contented to charge a fair price—and a price which the consumers of the article can well enough afford to pay—the necessity for opening up new sources of supply has not made itself obvious.

It will need an era of higher prices before the more remote sulphur deposits of America can compete with the Sicilian shipments to San Francisco; and though the position as regards Japan is one on which it would be somewhat hazardous to express a decided opinion, it hardly seems probable that any new arrangement which the Anglo-Sicilian Company may be about to make will be influenced by the fear of com petition from this source. In using the composite term, Anglo Sicilian Company, it may make the position of affairs more apparent if we say that it might, as far as its policy is concerned, be called the United Alkali Company, as Mr. Chance, whose name has frequently occurred in this article, is closely connected with the latter, while being the moving spirit of the former. It is hardly necessary to say that the Sulphur Company does not regard with great favor the application of the Claus kiln to the ammonium sulphate plants of gas works, as the sulphur recovered from this source is outside its control. The makers of sulphuric acid from brimstone, however, regard the matter in a different light, as they are enabled to buy their raw product in a cheaper market. In one district in the north of England, where the Claus kiln is in use at several works, there is a ready sale for all the sulphur produced, the sulphuric acid made from it being required for the manufacture of mineral waters, for which purpose the acid must be quite free from arsenic, an impurity which is always present in greater or less quantity in acid made from Spanish pyrites. It may be mentioned that the patent for the Claus kiln has lapsed, a fact which necessarily has had a good deal to do with its increased use of late.

We have referred to the impetus which the rise in price has given to sulphur mining in the States, and it may be added that a spurt has also been given to the working of the New Zealand deposits, the sul phuric acid makers of Australia now drawing their requirements from the sister colony instead of from Sicily or Japan as of old. To conclude, we have preferred not to indulge in any conjecture as to the nature of the new commercial arrangement which the Anglo Sicilian Company will shortly have to enter into, and pass without comment the rumor which comes from Hamburg, and which may or may not be well informed, to the effect that the new agreement to be made will include the whole output of Sicily. That our opinion is favorable to the combine will be apparent, and what we have said as to its serving a useful purpose finds support in what has been published in the Italian press. The case seems to be one where the adage *Vestigia nulla retrorsum* suggests itself as particularly appropriate, if the British sulphur manufacture is not to enter upon a period of decline.

Blue Printing.

The *Metal Worker* says that the subject of making blue prints has evidently aroused a great deal of interest on the part of its readers, and while much has been written about it, the numerous suggestions which are being offered by various correspondents indicate that it has by no means been exhausted. In this connection the following by A. B. Babbitt may not be out of place:

Blue printing is a process by which a number of copies may be made from one tracing, and is accomplished by exposing to the sunlight the tracing placed over a sensitive paper which possesses the property of changing color by exposure to the light. The sensitive paper is a tough, perfectly white paper coated on one side with a chemical solution.

If this paper is placed in water before exposing to the sunlight the chemicals will wash off, leaving the pure white paper, but after being placed in the sunlight a certain length of time and then immersed in water the sensitive side of the paper will turn blue.

With these two facts being known let us consider the effect produced by placing a drawing over the sensitive paper when exposing to the sun. We can readily see that the sun cannot penetrate the lines of the drawing, hence that part of the sensitive paper directly beneath the lines will not be affected by the sun's rays, while the rest of the paper having simply the paper or cloth on which the drawing is made between it and the sun, will be acted upon by the light.

Upon placing in water, that portion of the chemicals unaffected will wash off, leaving the white of the paper, while that part which has been touched by the light rays will be turned blue. This will give an exact copy of the drawing in white lines on a blue field.

Blue print paper can be purchased from the manufacturer in rolls varying from 10 to 50 yards in length, and from 24 to 48 inches in width. It is also made in three thicknesses—namely, thin, medium and heavy.

Paper of different degrees of sensitiveness can also be obtained, known as "quick printing" and "slow printing."

The quick printing paper, because of its great sensitiveness, is a convenience in cloudy weather, but is correspondingly difficult to handle on bright days. It will spoil much quicker than slow printing paper, especially in summer weather.

It is cheaper and better to buy the paper from the manufacturer than to prepare it for oneself. If, however, it is desirable to prepare it, chemicals in the following proportions may be used:

One ounce red prussiate potash in 5 ounces water. One ounce citrate of iron and ammonia in 5 ounces water.

These solutions should be kept in opaque bottles in a dark place and mixed just before using. Apply with a sponge or soft wide brush, and dry in a dark place. All these operations should take place in a dark room. The sensitive paper when dry should be kept in a dark, dry, cool place—dark, because affected by light; dry, because affected by dampness; cool, because affected, especially in summer months, by the humidity of the atmosphere.

From one to six minutes' exposure in a bright sun should give a good copy. Too short an exposure will produce a pale blue background; too long an exposure, a gray background with a very indistinct blue line. The length of exposure is dependent upon three conditions: First, the sensitiveness of the blue print paper, whether quick or slow printing; second, the thickness of the paper upon which the drawing is made—the sun will penetrate thin tracing cloth or paper much quicker than bond paper; prints cannot be taken through buff paper; third, the intensity of the sun's rays—the paper would have to be exposed longer at 4 P.M. than at midday, and longer during winter months than in the summer. Practice and observation alone will give the experience necessary to take good prints.

The sun's rays should be as nearly perpendicular to the plane of the paper as possible, so that there will be no danger of the light shining underneath the lines of the drawing, thus making the lines of the print indistinct. For the same reason the sensitive side of the blue print paper should be held in close contact with the tracing, and to accomplish this a device known as a printing frame is used, which consists essentially of a frame encircling a piece of glass and a removable back, held in place by springs or some similar device.

The tracing is placed with the ink side next to the glass and the blue print paper with the sensitive side next to the tracing. The back of the frame is next adjusted and the springs locked in their proper place. These springs accomplish the double purpose of holding the back in place and also of clamping the paper and tracing between back and glass, thus insuring close contact.

After exposing the proper length of time the blue print paper should be washed thoroughly in clear water—running water preferred—and then hung up to dry. The quick printing paper will require a much longer washing than the ordinary paper. From one half to three-quarters of an hour is none too long to wash a print.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, June 9, 1900.

"*Still Harping on My Daughter.*"—*A Large Reduction in the Cost of Welsbach Burners and Mantles.*—*Mr. A. E. A. Edwards on Artificial Lighting.*

The well known quotation with which I have headed the above synopsis of contents refers to the further continuation of my remarks on the state of the coal market, on which there has been something to say every month, of late. As regards supplies of gas coal over the ensuing twelve months, anticipation has now verged into certainty, and the reality is not of a more comforting or reassuring nature than the expectation. Most of the contracts have now been arranged under terms from 4s. to 8s. per ton higher than those prevailing a year ago, and under conditions, as regards maintenance of supply, liability of failure, etc., that are much less onerous than those obtaining a twelvemonth ago. In fact, some contractors are so carefully hedged in, against liability for delay caused by short time, accidents at pits, want of trucks, any action or neglect on the part of railway company, and so on, that it is difficult to see where the advantage of the contract, so far as the gas company are concerned, comes in. In making comparisons, the

fact must not be overlooked that coals have been moving upwards in price for the last three years, and previous to the present advance had obtained a position 1s. to 1s. 6d. higher than the average or mean level. And the great question to be faced is how this large increase of expenditure is to be met. The coke trade has been excellent since last autumn, and those whose coal requirements are fully covered up to midsummer have been able to score some advantage. Under normal circumstances it is very good working if the average price received for coke, after paying all expenses, comes somewhere near to that paid for coal. If coal costs 14s. per ton delivered into stores, there is not much the matter if the average net receipts for coke come up to 14s. But during the past six months it has been possible to do better, and many who pay 14s. for coal have realized 16s., or even 18s., for coke. But this point must not be too strongly labored, because the thing cuts both ways. Gas companies must make sure of a winter supply and must contract some months ahead. Although the brisk demand for gas coal, which set in earlier than usual this spring because stocks had been greatly depleted during the past winter, more than was expected, acting upon an already stiff market, and assisted by trusts, combinations and every possible artificial means, has raised gas coals to an unprecedented price, one cannot be sure that such a condition of things will be maintained until midsummer, 1901. If gas coals keep stiff there may be a drop in the house or steam coal trade that will mean a corresponding fall in the price of coke. Even before the bulk of next season's make of coke is in existence, important changes may take place and will considerably interfere with calculations based upon the present value. After making every possible allowance for the help to be derived from residuals, or for the possibility of cutting down repairs and other expenses, there will remain a considerable deficiency to be covered either by the accumulated funds or by increasing the price of gas. As noticed last month, many have accepted the second course. There is no alternative. If the consumer is to share in the blessings attendant upon the piping times of peace, he must also be willing to take his part of the burden when things are unsettled and unfavorable.

There is something amusing as to the variations in the extent of the advance. Out of 42 notices of increase that have come to my knowledge as being made during the last few weeks, one was for 2d., one for 2½d., eight for 3d., an equal number for 4d, seven for 5d., nine for 6d., one for 7½d., two for 9d. and five for 10d. per 1,000 cubic feet in each case, the average being nearly 5½d. As to the causes, of such a wide variation, the first thing to be considered is the actual selling price in each case. A rise of from an original price of 5s. to 5s. 6d., though greater in amount, is a smaller percentage than if the advance is 3d. on a price of 2s. But you will be able to judge from these statistics that the rise is a general one, and that it will be sufficiently widespread to enable the collection in a twelvemonth's time of some facts bearing on the effect of a rise of price in consumption. Some people claim that a reduction stimulates consumption, and conversely we may expect that an all round rise to the extent of about 5d. will operate in the other direction.

The Welsbach Incandescent Gas Light Company have come forward at this juncture with important announcements respecting the future prices, as from the 1st inst., of their burners and mantles. According to information which has been extensively circulated amongst the trade, the various makes of burners can now be retailed at prices ranging from 2s. 6d. to 5s. 9d. each, complete with mantle and chimney, the previous rates being 4s. to 8s. 6d., or 50 per cent. higher. Mantles for renewals can be sold for 7½d. each, instead of 1s., and rods for 6d. per dozen, just one-half of the previous price. And this is not done at the expense of the retail vendors, as the trade terms have been revised and made more advantageous than before, while at the same time the Company, evidently determined not to do things by halves, are prepared to assist their agents by the supply of show rails, posters, enameled letters, circulars with the local name and address, and will also give careful attention to complaints or difficulties that may be experienced. This is indeed good news for consumers of gas. Those who use this system, assuming they have to bear a 5d. rise, will be no worse off than before, as the increase in gas will be compensated for by the cheaper mantles. And those who have not as yet adopted the system can do so and actually save money. Having on previous occasions spoken somewhat adversely of the business methods adopted by this Company, I feel the more pleasure in congratulating them on the foresight and enterprise now exhibited, which will assuredly bring its own reward. The Company have probably noted the great extension in the use of gas amongst the artizan classes, and that these new consumers, as a body, hold aloof from the incandescent system on account of the cost of appliances.

The ensuing winter will see the half-crown burner enlivening many a humble home, affording a light equal to anything that the latest sources of modern science can provide, at a price that leaves all other competitors entirely out of the running.

The new prices will be very gratefully accepted by those gas companies, not a few, who have adopted the system for street lighting and also taken up the question of maintenance. The one leads to the other, because when people see a well kept system in use in the streets and thoroughfares they wish to have the same in the interior also. The men who see to the street lights soon become known as experts, and their advice is sought for by those who experience difficulty in keeping the mantles or burners in good order. And so it usually happens that those who have a standing street lighting contract have gradually developed a maintenance business. In many cases it has extended to double or treble the number of street burners. At previous prices it was barely possible to conduct a maintenance department at cost, to say nothing of a fair trade profit or provision for contingencies. Customers are apt to look on a fixed charge per burner per quarter as a tax or an additional liability. "What! 6d. per burner for my three dozen lights. Why that is £3 12s. per annum." They are not, as a body, educated up to the point of perceiving that the gas bill of the future plus the £3 12s. need not and will not be so much as the gas bill of the present. But the appreciation of this fact is gaining ground surely, if slowly, and the prospect of a good harvest from seed sown by undertaking maintenance of incandescent appliances on easy terms becomes brighter and brighter every day. The incandescent gas burner, properly looked after and maintained, is by far the best and cheapest light extant. But it is a mistake to minimize the fact that it requires periodical cleaning and attention. The trouble involved in lifting off a mantle, blowing out the burner and polishing the glass is, after all, merely a trifle. But it is very apt to be overlooked or neglected, with the result that the system is blamed for the indifference or slovenliness of the user. The new price schedule will not only encourage those who already have the subject well under control, but will lead other companies, who up to the present have held aloof, to appreciate the importance of the facts just mentioned.

An interesting paper on artificial light, with special reference to engineers' shops, was recently read before the Birmingham Association of Mechanical Engineers, by Mr. A. E. A. Edwards. The author makes some very pertinent remarks on the reflecting power of various surfaces, pointing out that by keeping the walls cleanly whitewashed and painting machines a light color, a very considerable saving of light may be effected. A good light, or otherwise, has a marked effect on the amount of work done, and the case of a French railway warehouse is quoted, where, as a result of improving the lighting, the amount of work per man was increased to the extent of 30 per cent. Attention was also directed to the obstruction to light caused by clear glass, ground glass, opaline and other materials in ordinary use for the protection of the flame or diffusion of the light. As to the position of the lights, the author is equally clear and practical. After these general remarks he has something to say about oil, gas, acetylene and electricity, and in referring to the Welsbach system mentions an important improvement introduced by Mr. Barratt, Superintendent of the Birmingham Corporation gas fittings department. This consists of causing the air supply to impinge on the outside instead of the inside of the mantle. The ordinary inlet between the burner and chimney is stopped, and the chimney is raised till the lower edge is just above the base of the mantle. This plan is said to increase the candle power about 20 per cent. and to prolong the life of the mantle. If the burner is periodically cleaned the depreciation of light is not so much as is generally supposed, and the author has had a Kern burner in use for 1,200 hours, and the light is quite as good as at first. Many gas consumers would save money by acting upon Mr. Edwards' suggestions, and his remarks might be circulated with advantage amongst owners of factories, large shops and all who require to efficiently light large buildings or areas.

In speaking of ordinary union jets the author recommends frequent renewals, and shows that directly the flame is pointed or irregular it pays to reject the burner.

SUPT. KNOWLES, of the Richmond (Va.) City Gas Works, is busily engaged in carrying out the scheme of plant improvement agreed upon some weeks ago. The main features of the scheme are: A new engine and boiler room, the remodeling of the generator plant and the rearrangement of the oil storage system. The work will be completed by Sept. 15.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. HENRY L. DOHERTY, writing from Madison, Wis., under date of June 23d says:

To the Editors AMERICAN GAS LIGHT JOURNAL:—I have just read your comments on my paper before the National Electric Light Association, entitled "Equitable Competitive and Uniform Rates."

You quote just enough to put me in an undesirable light with the gas fraternity, and as I risked offending the electrical fratenity by my honest views I ask permission to continue the quotation. I said:

"I do not attempt to place gas in any order of importance, as its future for lighting is largely problematic, and should I give the possibilities I see for this agent it might lead the discussion from the real merits of the subject of my paper. I will consider it only in the sense of its present development. * * * Aggressive competition with gas is apt only to precipitate an active war which will be harmful to both companies. * * * Better let the gas company supply the customer you cannot supply profitably, and aim to get in return a long-hour customer that you can supply profitably."

Nothing is gained by ridiculing the idea that electricity can compete with gas. We must recognize conditions, not sentiments. To lull the gas fraternity into the belief that electricity cannot compete will injure rather then help them.

It may sound strange to refer to natural light as a competitor, but my statement when properly presented called forth no adverse criticism from a large body of able and intelligent engineers, and I cannot offer better defence than to quote from a letter recently received from an architect, in which he says: "You are right in a way, for it often costs more to provide natural light than to buy artificial light."

I have occupied three positions in the lighting business: First, as a gas man competing with electricity; second, as an electrical man competing with gas; third, as the manager of a combination gas and electric company, with no other central station competition. The last position proved the most acceptable; and, judging by the number of combinations between gas and electric companies during the past few years, I feel sure many other gas men agree with me.

THE proprietors of the Coatesville (Pa.) Gas Company, have secured control of the properties of the Citizens Gas Light and Fuel Company, of Downington, Pa.

THE organization of a gas company for Steelton, Pa., is practically assured. This would have been accomplished long ago were it not for the sturdy opposition made to the plan by the owners of the local electric lighting company.

THE new net gas rate at Malden and Melrose, Mass., of $1.20 per 1,000 is now in effect. The concession amounts to 10 cents per 1,000.

THE main system of the Huntsville (Ala.) Gas Light Company is being overhauled.

MRS. LEMCKE recently concluded a very successful series of demonstration lectures on cooking by gas, under the direction of the Consumers Gas Company, of Newburgh, N. Y.

THE authorities of Great Falls, Mont., are still considering the proposition submitted to them by Mr. Allen F. Shewmon for the establishment there of a gas works.

THE Burlington (Vt.) Gas Company reports a brisk demand for gas ranges, many of which orders were received from persons who were thus to make their initial trial in the use of gas for any purpose.

THE shareholders of the Northern Liberties Gas Company, of Philadelphia, Pa., will meet to-day to ratify the proposed lease of their property for a period of ninety-nine years to the United Gas Improvement Company.

RECENT advices from Madison, Wis., are to the effect that the Madison Gas and Electric Company will next fall institute a profit sharing system with its employees.

THE Macon (Ga.) *News* says that on the morning of June 22d Mr. T. D. Tinsley filed his final report as receiver for the Macon Gas Light and Water Company with the Clerk of the United States Court for the district. The report was finally accepted June 28th, and the Company's properties are again under its direct control.

A CORRESPONDENT forwards the following from Charlestown, Mass., which, though rather belated, in that it refers to a happening of well over a fortnight ago, is printed as a well told story of a highly successful demonstration: "At the invitation of the Charlestown Gas and Electric Company an audience numbering 150 people, mostly women interested in practical methods in the home, assembled some days ago in Odd Fellows Hall, to listen to an instructive and highly entertaining lecture on the art of modern cooking by gas. The lecturer, Miss Elizabeth K. Burr, trim in attire and gracious in presence, proved a fascinating speaker, and her readiness to answer all questions relating to cooking by gas elicited the appreciation of those present. Miss Burr was assisted in her demonstration by several young ladies. The stage of Odd Fellows Hall was a unique sight with the gas ranges and various appliances which presented the appearance of a modern kitchen. The women who were present carried away many useful suggestions which they jotted down in notebooks provided for the occasion. Miss Burr, in opening the demonstration, said: 'The object of cooking should be that the proper ingredients should be so used together that the food may taste well.' She emphasized the importance of measuring quantities as against the old guess work custom, and laid stress upon the necessary temperature, which she aptly illustrated by turning on and shutting off the gas at the proper times. Turning off the heat of the oven when food was being baked occasioned much surprise. Light, delicious sponge cake, scalloped fish with white cream sauce, wholesome bread and the juicy sirloin were cooked to perfection by Miss Burr with ease and facility. This delectable menu was daintily served to her hearers at the close of the lecture, and with the munching of the choice viands the prosaic element of household drudgery disappeared in visions of what may be accomplished in this prevailing era of comfortable cookery by modern appliances. Although the home-maker sometimes sings about her work, the kitchen is not often invaded as happily as on this occasion, when Mr. James M. O'Brien, of Charlestown, took possession at intervals throughout the lecture, and with his rich, powerful voice captivated the audience in several selections, which drew forth hearty applause. Mr. Bart. Grady, organist of St. Anne's church, rendered delightful piano music as a prelude to the lecture."

THE Directors of the Consolidated Gas Company, of Baltimore, Md., have declared an extra special dividend of 2½ per cent., payable July 7th to holders of record of June 30th. This action was in the nature of a decided surprise.

THE Pintsch Compressing Company, of New York, is constructing a new plant at Fremont and Wayne streets, Jersey City, N. J. At this station it is intended to manufacture the gas used for the lighting of the passenger coaches of the Pennsylvania and Lehigh Valley Railroads.

THE Indianapolis (Ind.) *News* says that electrolysis is made the basis of an action begun some days ago in the Superior Court by the Manufacturers' Natural Gas Company against the Indianapolis Street Railway Company. The complaint was filed by Miller, Elam and Fesler. It is stated in the complaint that $500,000 was expended in placing the system of piping in the streets, and that the 24 miles of pipe inside the city and the 100 miles outside have cost a large sum for maintenance. At the time the pipes were placed in the streets the old Citizens' Street Railroad Company was running the mule cars. Later the animal power gave place to the overhead trolley system. This change was made possible by a permit issued by the Board of Public Works, and the Common Council. By this system the electric power is conveyed to the car by a single trolley wire, reinforced by feed wires at regular intervals. Theoretically the current is conveyed back through the car to the rails, and thence to the power house. But, the complaint charges, instead of the current going to its destination by way of the car track, it seeks, by the laws of nature, the best conduit. The wrought iron gas pipes are excellent conduits, and it is charged that the greater portion of the current passes through them. A result in the nature of disintegration, it is alleged, is produced. As the years have passed by and the street railway system has increased, it is asserted the Gas Company has been contending with the difficulty of taking up its pipes to find what is wrong with them. Almost invariably in a street where a car line is located it is alleged deterioration, caused by electrolysis, is found to be the cause of leaks. The complaint names several places where repairs have been necessary recently on account of electrolysis. In front of the street car barns in

West Washington street extensive repairs were necessary and also in Brush street. A number of other streets were torn up and new mains put in. The aggregate cost of the repairs, it is charged in the complaint, were $7,500. Other damage to the pipes has been done, the complaint states, but an examination to show the extent would be impracticable on account of the necessity of unearthing all of the pipes. This is all caused, the complaint alleges, by inadequate means for the return of the current. Judge Carter, in whose room the suit was filed, is asked to compel, by injunction, the street railway company to provide adequate return conduits and to award damages in the sum of $50,000. Another allegation set up in the complaint is that the danger of explosion and the probable liability of the Company for damages resulting have caused the Gas Company much anxiety. The difficulty and expense of making repairs is greatly increased, the complaint charges, by the pipes being charged. About a year ago the gas, water and electric light companies combined in hiring the services of an expert to examine the pipes and conduits. His oral testimony will probably be a part of the evidence introduced in the trial of the case. The other companies affected, it is understood, are prepared to bring suit in case this suit filed is successful.

MR. C. C. HOWELL, the active manipulator of the opposition gas concern of Knoxville, Tenn., says that the sale of the old Knoxville Gas Light Company to Mr. Isaac C. Baxter and his associates will have no effect on his plans. The registered name of the Howell bantling is the Tennessee Gas and Coke Company.

MR. D. MACLACHLAN, formerly of Tallahassee, Fla., has been appointed Superintendent of the plants of the Greenville (S. C.) Electric and Gas Company.

THE annual meeting of the Nashville (Tenn.) Gas Company will be held on the 18th inst.

A CORRESPONDENT in Omaha, Neb., writing under date of June 25th, forwards the following:

"The New York Security and Trust Company, as trustee for the holders of the bonds of the Council Bluffs Gas and Electric Company, has filed a bill of complaint in the United States Court here against the city of Council Bluffs, Mayor Jennings and the Council Bluffs Gas and Electric Company, asking an injunction preventing the former from enforcing the ordinance recently passed by the City Council and signed by Mayor Jennings, fixing the rate for gas at $1.35 per 1,000 feet, and preventing the Gas and Electric Company from accepting the terms of the ordinance or conforming to its requirements. The complaint alleges that the enforcement of this rate would so impair the revenues of the Gas Company that it could not meet the interest on its bonds and provide for payments to the bond sinking fund, and it is claimed the ordinance is therefore an attack on the constitutional rights of the complainant, in that it seeks to take property for public use without due recompense and without due process of law. The temporary injunction has been issued by Judge McPherson and the date for hearing fixed August 1. The bill of complaint sets out the fact that the light committee of the City Council, after investigating, reported to the Council $1.60 per 1,000, with 10 cents per 1,000 reduction for payment within a limited period after bills for lighting became due, was a reasonable price, and declares that in case the city attempts to enforce the ordinance for $1.35 per 1,000 feet, patrons of the Company will refuse to pay more than this price and that the result will be a multiplicity of suits involving an expense greater than the amounts to be collected by the Company, and the loss of much of its revenue. The complainant asserts that the city has no power, either under the laws of the State or the ordinances of the city, to arbitrarily fix an absolute price for gas, or the candle power of the gas which must be produced. It is set out that section 725 of the 1897 code, which is the authority for the ordinance recently passed by the Council, was enacted subsequent to the granting of the Company's franchise.

"A 24-candle power gas is declared to be unreasonable for the reason that much of the illuminating gas used in this city is burned in Welsbach burners, or similar burners. Gas of 24-candle power is rich in oils and smokes the mantles of such lights and causes them to break, and while it would be more expensive to produce, it would give no better satisfaction to those who use the ordinary burner, and would be unsatisfactory to those using the Welsbach burners.

"The bill of complaint flatly asserts that $1.35 per 1,000 is an unreasonably low rate for gas under the circumstances. In support of this contention the complainants make a statement of their receipts and expenditures during the year 1899, as follows:

Receipts:			
From gas		$44,185.63	
From electric light		22,263.84	
Total receipts		$66,449.47	$66,449.47
Operating expenses and maintenance		$51,913.80	
Fixed charges:			
Interest on bonds	$13,850		
Sinking fund	5,000		
		$18,850.00	$70,763.80
Deficit			$4,314.33

"The complainant says that upon a rate of $1.35 per 1,000 its revenue from gas during 1899 would have been only $37,219.23, and its deficit would have been proportionately larger. Attention is called to the fact that the Company had advantageous contracts during 1899 for material and labor. These contracts are now at an end and the cost of material and labor is much larger than the prices paid during 1899. Computing according to present prices, it is estimated that the operating expenses of the Company during 1899 would have been increased over what it actually was by about $7,841.46. This increase would have made the cost of operation in 1899 $59,755.25. The total income in 1899, had the rate for gas been $1.35 per 1,000, would have been but $59,483.07, and the deficit would have been raised to $19,133.19. The complainant asserts that the average of the last 5 years would show a still larger deficit than that for 1899 alone."

THE plant of the Fort Scott (Kas.) Light and Fuel Company was sold at public auction the morning of June 20th. The purchaser was Mr. Samuel T. Bodine, of Philadelphia, at his bid of $54,700.

A Decision Relating to Electric Furnaces.

Frequently a suit arises over a patent that threatens to revolutionize the methods of an entire industry. The famous Berliner case was such a one, while still more recently a decision was handed down in Philadelphia which may seriously affect, if not entirely cripple, some of the large manufacturers of products requiring electric furnaces. The suit in question is that of the Electric Smelting and Aluminum Company, of Cleveland, O., versus the Carborundum Company, of Niagara Falls, N. Y., for infringement of patent rights. The patent involved is one issued to E. H. and A. H. Cowles on June 9, 1885, for an improvement in processes for smelting ores by the electric current.

The Cowles patent covers the mixing of carbon with the substance to be reduced, which causes a far greater resistance to the passage of an electric current, a consequent rise in temperature and diffusion of heat throughout the mass.

While experimenting with such a furnace many years ago—so the story runs—the Cowles brothers attempted to fuse common sand into rock crystals. A core of carbon fragments was imbedded in the sand, and the current turned on. After an interval the furnace was opened and a considerable quantity of fused sand was removed. In the center of the mass next to what had been the core of carbon, was found a small quantity of crystals nearly as hard as diamonds. These were thought to be crystals of the element silicon, of which sand is an oxide. Little more attention was given the matter by the Cowles brothers, who turned their attention to the manufacture of aluminum, until Mr. E. G. Acheson, who perfected the process for the manufacture of carborundum, exhibited his product in the various stages of manufacture at the World's Fair in Chicago, in 1893. Mr. Alfred Cowles then recognized, or thought he recognized, the crude product as identical with the crystals which he had made. The result was that a suit for infringement was begun. The case was tried before Circuit Judge Buffington in the Western District of Pennsylvania, and was decided adversely to the complainant. In summing up his decision the Judge said:

"Indeed, the process, preparation of ingredients and means employed in the two processes now under consideration are diverse and the desired objects unlike. A like thermo electric agent is employed in both, but with it the substantial likeness ends. Cowles' object was reduction, while Acheson's was composition. One reduced a substance

(*Concluded on page* 14.)

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already in existence, the other by composition produced a new product. With Acheson the new product consumed the carbon constituent of the charge; with Cowles an excess of carbon constituents remained at the close of the process. In Cowles', the charge for functional purposes, occupied the central space between the electrodes. In Acheson's, for functional purposes it was removed from such central space and from electrode contact. In Cowles' an excess of carbon was required in the charge mixture as a current conductor; in Acheson's no such excess was required or used, but the carbon for that purpose was isolated in the central core. Their methods are so radically unlike and are carried out on such diverse lines that we are firmly convinced that the charge of infringement has not been sustained."

The case was appealed and reargued before Judges Gray, Dallas and Bradley, sitting in Philadelphia as the Circuit Court of Appeals. Before a decision was rendered, Judge Bradley retired from the bench, and at the request of the Court the case was again reargued. Judge Bradford, who succeeded Judge Bradley, writes the decision recently handed down. In his decision he lays stress on "the disposition of the resistance material with respect to the material to be treated." It points out that in the Cowles patent claims it is stated that the ore "is usually mixed with the body of granular resistance material," which implies the two need not always be mixed. It points out that, although the description of the process which accompanied the application for the patent mentions mixing the ore and carbon, as does one of the four specific claims made for the patent. The language of the other claims, in the estimation of the court, require merely contact in contradistinction to mixture between the resistance material and the material to be treated. The decision is, therefore, that claims 1, 2, and 4 of the Cowles patent have been infringed."

The case will in all probability again be appealed. If the present decision is sustained it will prove a very serious matter, not only to the Carborundum Company but to other concerns engaged in the manufacture of products requiring the use of electric furnaces. There would seem to be a chance, however, of the patent expiring before the litigation comes to an end.—*Electricity.*

The Market for Gas Securities.

The sequence of events, so far as one may judge by the scant announcements of those who are in charge of the sequeling, in the matter of the gas and electric supply of New York and Queens counties, points to absorption of the completest sort. The last sale by those in charge of the Consolidated Company to themselves, respecting outside things that individually they've owned for quite a while, will be the gas and electric lighting interests of Queens county—Flushing, Jamaica and other smaller places are included in the job lot. To day (Friday) is "the last day" for the reception of Standards under the agreement. Those who did not "agree" to the terms need have no fear that their property will be lost. Another "stray property" seems to be Mutual, but that is also a good one to hold, plus the 300 point. In order to meet the responsibility attaching to these various other purchases, a "majority of the Board of Trustees" have called a special meeting of the Consolidated Gas Company, to be held in Irving Place, July 16th, for the purpose of voting on a proposition to increase its capital stock from $54,595,200 to an amount not exceeding $80,000,000. The increase will be made; and such increase will, it is hoped, be partly applied to the redemption of the Mutual Company's shares.

After July 16th it is in order to believe that some mention will be officially put out of the existence and ultimate standing of the Astoria Light, Heat and Power Company, which corporation is likely to be the graveyard of Mr. Gawtry's speculative ambition. The announcement of the special meeting conveys the intimation that holders of record on and after July 16th "may be given" the right to subscribe for Consolidated Gas, at $150 per share, in 25 per cent. of their holdings. Our advice to the innocents is to subscribe, so that they may come in for a trifle of that which is left. The notices have had a bad effect on the price of Consolidated; from our point of view the result should have been an increase. During the week the stock sold as low as 171, to-day it is 175. It is more of a buy than a sell.

The general gas share list has held its own fairly well, although as a rule weakness is its characteristic in common with the general share market. A pyrotechnic feature of the outside market was the declaration of a 2½ per cent. extra dividend on Baltimore Consolidated. Bay State valuations have approached the political level of Mr. J. Edward Addicks. Peoples, of Chicago, is cheap. The Hartford (Conn.) Company has declared a semi-annual dividend of 4 per cent., which looks a fair return on independent gas trading in a city where gas is sold at $1 per 1,000.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 2.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,200	100	175	175¾
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.	13,000,000	100	..	24
Preferred	10,000,000	100	..	48
Bonds, 5's	11,000,000	1,000	103¾	103¾
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	343,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	140	146
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	114
Yonkers	299,65	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	164	166
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1	1¼
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	.	35
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47¼	50
Buffalo City Gas Co.	5,500,000	100	5¾	6¼
" " Bonds, 5's	5,250,000	1,000	64	67
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,050,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,882,780	100	60	65
Preferred	3,026,500	100	84	86
Consumers. Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	200¾	201
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	50	50¼
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12½	15
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100½	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	90	100
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co.	350,000	50	72	73
" 1st Mtg. 5's	250,000	1,000	101	103½
Kansas City Gas Light Co., of Missouri	5,000 000	100	..	36
Bonds, 1st 5's	3,825,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	71	74
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	110	110½
Lafayette Gas Co., Ind.	1,000,000	100	40	45
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	
Madison Gas & Elec. Co.	400,000	100	75	80
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184½
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
Essex and Hudson Gas Co.	6,500,000	..	35	40
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	96¾	97
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111½	111¾x
2d "	2,500,000	1,000	104	106
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47½	47¾
St. Paul Gas Light Co.	1,500,000	100	57¼	58½
1st Mortgage 6's	850,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,498,000	1,000	88	89½
St. Joseph Gas Co.	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	98½	98
Syracuse, N. Y.	1,750,000	100	..	14
Bonds	1,612 000	1,000	88½	93

Washington, D. C	2,000,000	20	270	271
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
Bonds, 5's	3,830,500	.	104	106
Wilmington, Del.	400,000	50	200	210

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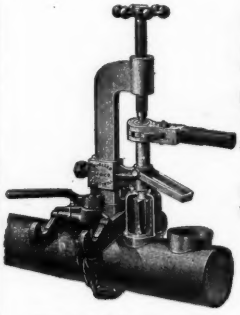

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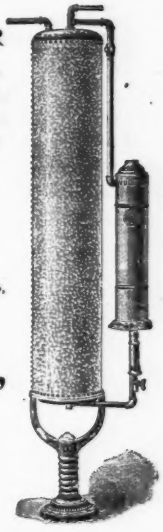

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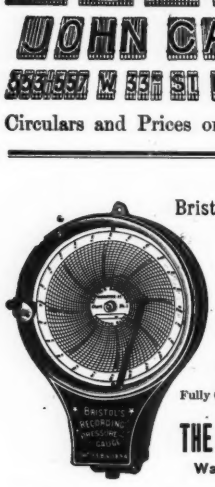

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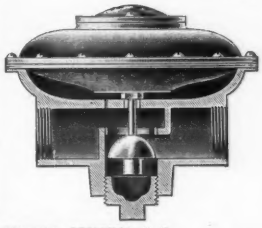

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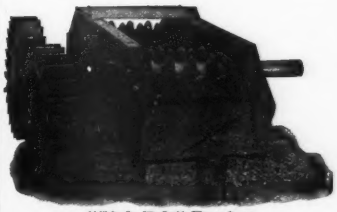

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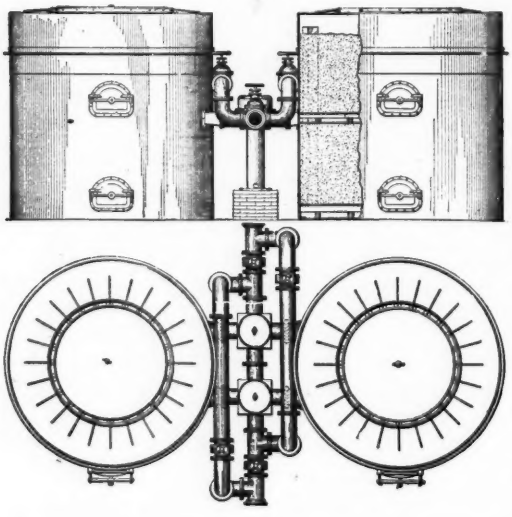

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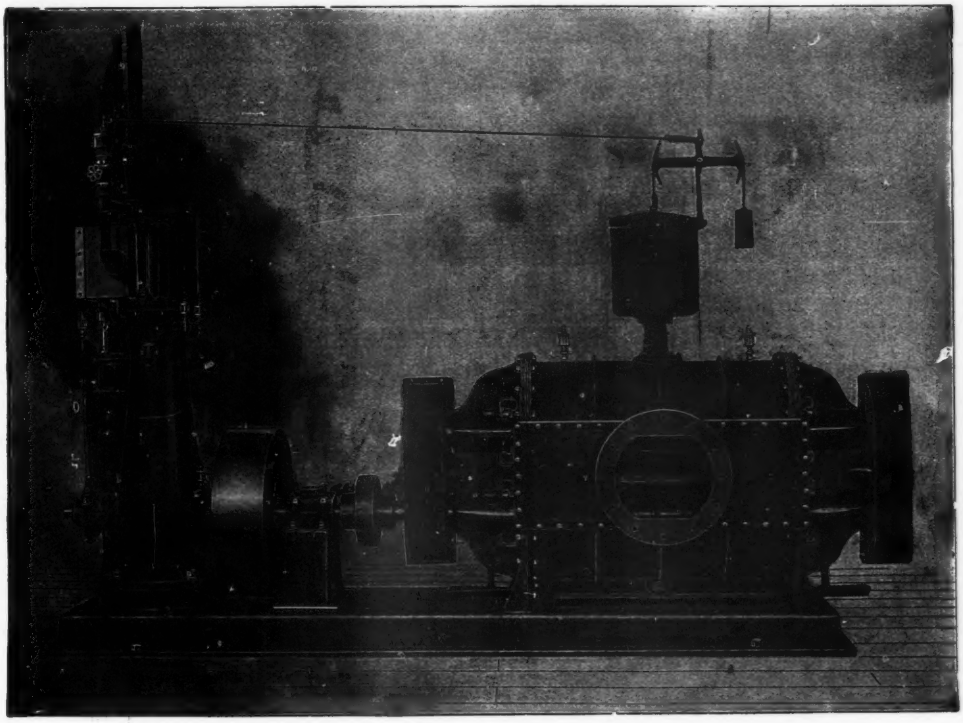

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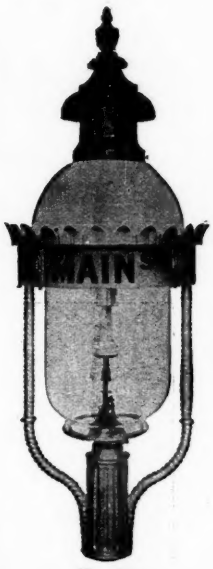

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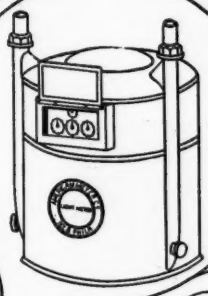
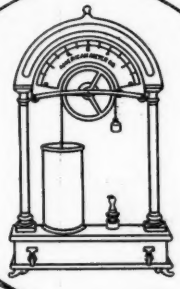
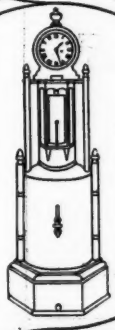
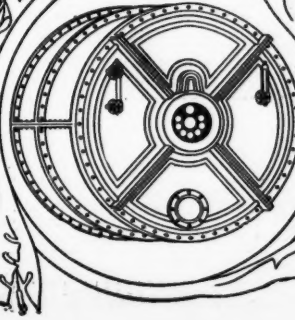
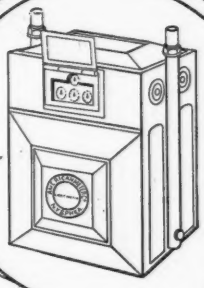
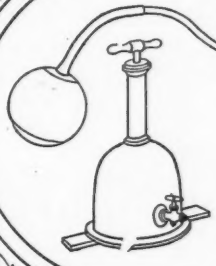


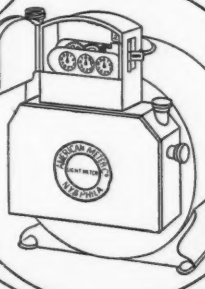












PUBLIC LIGHTING TABLE.

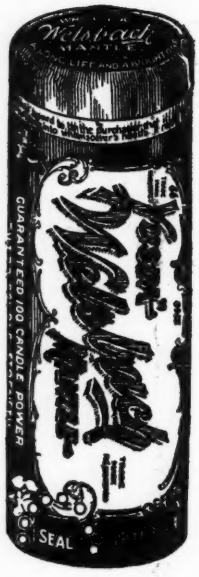
JULY, 1900.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	9.00 PM	3.40 AM	7.30	3.15
Mon.	2	9.30	3.40	7.30	3.15
Tue.	3	10.00	3.40	7.30	3.15
Wed.	4	10.20 FQ	3.40	7.30	3.15
Thu.	5	10.50	3.40	7.30	3.15
Fri.	6	11.20	3.40	7.30	3.15
Sat.	7	12.00	3.40	7.30	3.15
Sun.	8	12.50 AM	3.40	7.30	3.15
Mon.	9	1.40	3.40	7.30	3.15
Tue.	10	2.40	3.40	7.30	3.15
Wed.	11	No L.	No L.	7.30	3.15
Thu.	12	No L. FM	No L.	7.30	3.15
Fri.	13	No L.	No L.	7.30	3.15
Sat.	14	8.00 PM	9.40 PM	7.30	3.15
Sun.	15	8.00	10.20	7.30	3.15
Mon.	16	8 00	10.50	7.20	3.15
Tue.	17	8.00	11.20	7.20	3.15
Wed.	18	8.00 LQ	11.40	7.20	3.15
Thu.	19	8.00	12.50 AM	7.20	3.15
Fri.	20	8.00	1.20	7.20	3.15
Sat.	21	8.00	2.00	7.20	3.15
Sun.	22	7.50	3.00	7.20	3.15
Mon.	23	7.50	3.50	7.20	3.15
Tue.	24	7.50	3.50	7.20	3.15
Wed.	25	7.50	3.50	7.20	3.15
Thu.	26	7.50 NM	3.50	7.20	3.15
Fri.	27	7.50	3.50	7.20	3.15
Sat.	28	7.50	3.50	7.20	3.15
Sun.	29	7 40	4.00	7.20	3.15
Mon.	30	7 40	4.00	7.10	3.30
Tue.	31	8.20	4.00	7 10	3.30

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45

"YUSEA"



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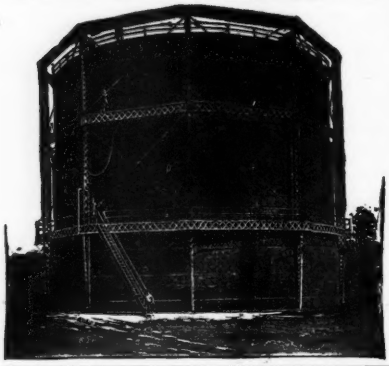

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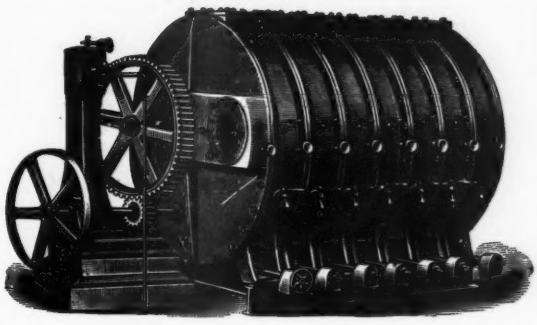

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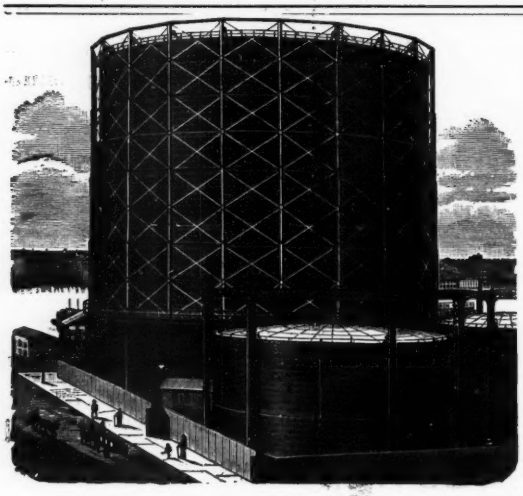

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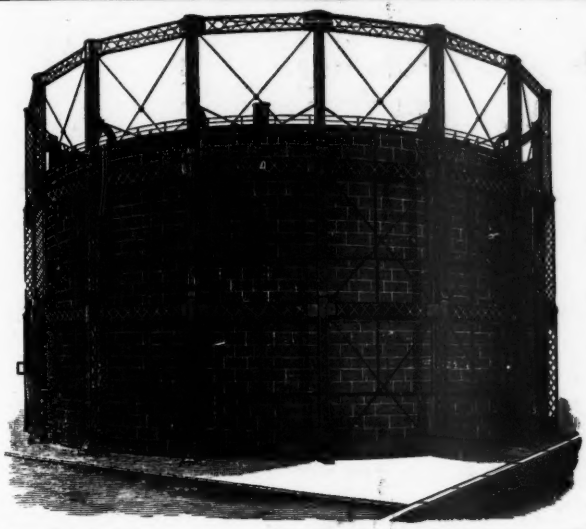

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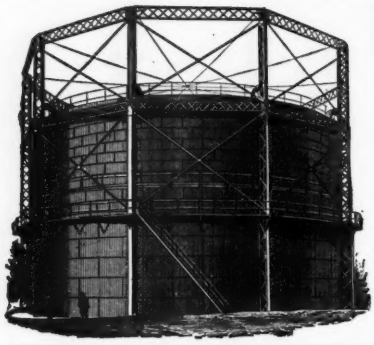

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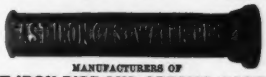

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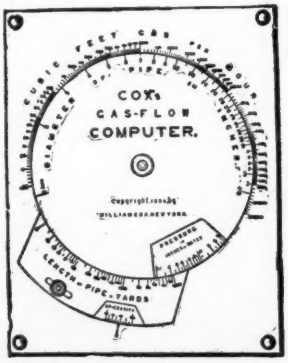

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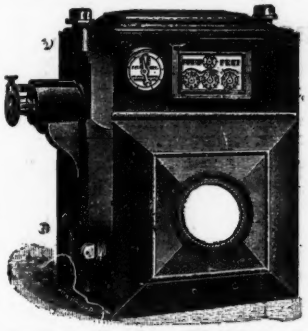

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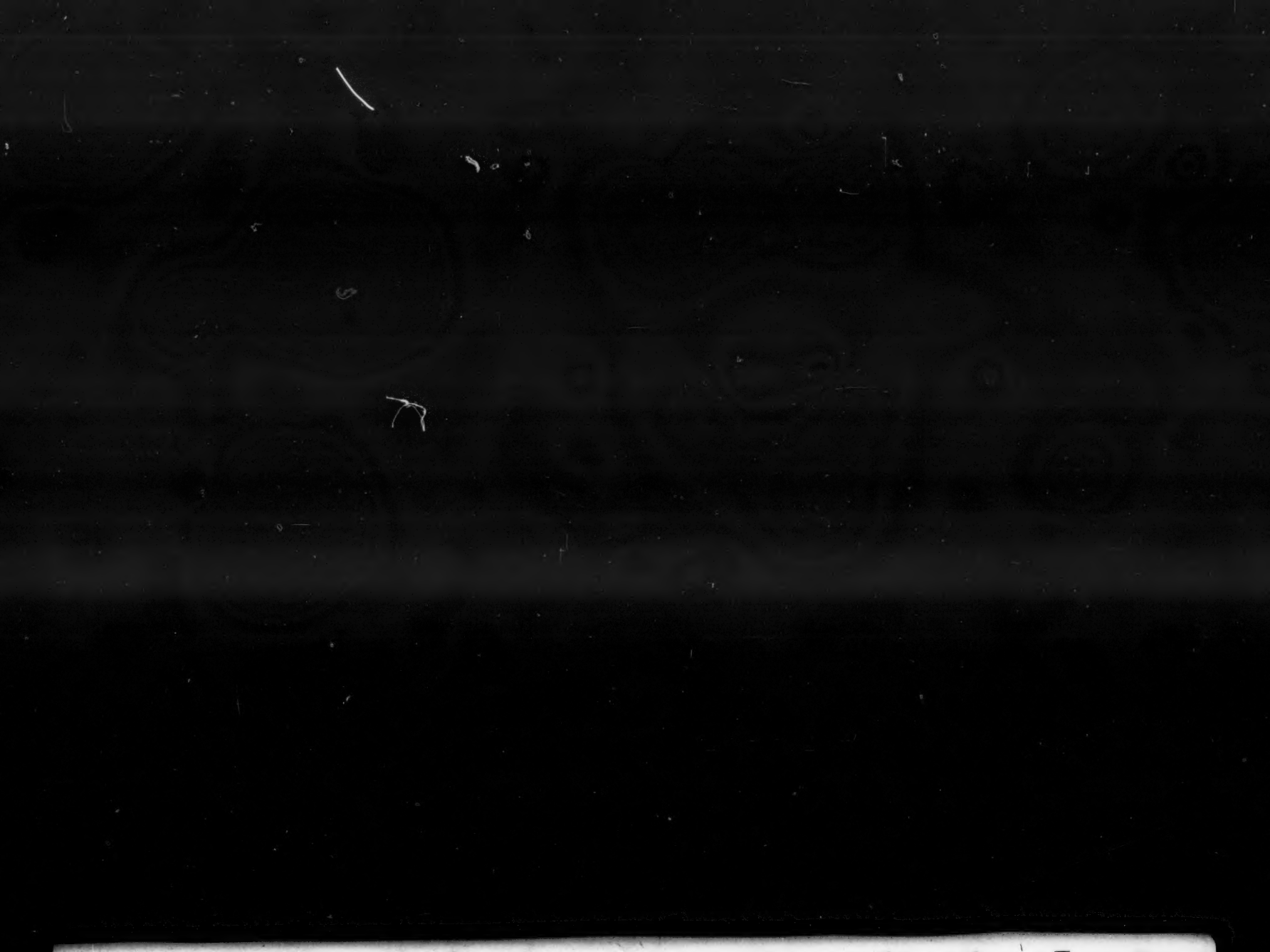
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